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1976

Volume III

AREA REPORTS: INTERNATIONAL

Prepared by staff of the

BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR • Cecil D. Andrus, Secretary

BUREAU OF MINES

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities to protect and conserve our land and water, energy and minerals, fish and wildlife, and park and recreation areas, and for the wise use of all those resources. The Department also has a major responsibility for American Indian reservation communities and for the people who live in Island Territories under U.S. administration.

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Foreword

The Federal Government, through the Minerals Yearbook and its predecessor volumes, has reported annually on mineral industry activities for 95 years. This edition discusses the performance of the worldwide mineral industry during 1976. In addition to statistical data, the volumes provide background information to assist in interpreting the year's developments. Content of the individual volumes follows:

Volume I, Metals, Minerals, and Fuels, contains chapters on virtually all metallic, nonmetallic, and mineral fuel commodities important to the domestic economy. In addition, it includes a general review chapter on the mineral industries, a chapter on mining and quarrying trends, and a statistical summary.

Volume II, Area Reports: Domestic, contains chapters on the mineral industry of each of the 50 States, the U.S. island possessions in the Pacific Ocean and the Caribbean Sea, and the Commonwealth of Puerto Rico. This volume also has a statistical summary, identical to that in Volume I.

Volume III, Area Reports: International, contains the latest available mineral data on more than 130 foreign countries and discusses the importance of minerals to the economies of these nations. A separate chapter reviews the international mineral industry in general and its relationship to the world economy.

The Bureau of Mines continually strives to improve the value of its publications to its users. Therefore, the constructive comments and suggestions of readers of the Yearbook will be welcomed.

Director

Acknowledgments

The Bureau of Mines, in preparing this volume, utilized extensively statistical and other basic data on mineral production, consumption, and trade provided by various foreign government mineral and statistical agencies through a variety of official publications. The cooperation and assistance of these agencies is gratefully acknowledged. Statistical and informational material was also obtained from airgrams of the U.S. Department of State, from United Nations publications, and from the domestic and foreign technical and trade press. Of particular help in preparing this volume were the routine and special reports submitted by the minerals, petroleum, economic, and commercial officers and other members of the Department of State. Their contributions are sincerely appreciated.

The text and tables of this volume were prepared by the staff of the Branch of Foreign Data, Division of Production/Consumption Data (formerly Assistant Directorate—International Data and Analysis of the Associate Directorate—Minerals and Materals Supply/Demand Analysis). Final correlation and checking of this volume were performed by the Minerals Yearbook staff of the Division of Publication (formerly Technical Data Services).

The regimes of some countries reviewed in this volume are not recognized by the U.S. Government. The information contained herein is technical and statistical in nature and is not construed as conflicting with or being contradictory of U.S. policies toward these countries.

ALBERT E. SCHRECK, *Editor-in-Chief*

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Minerals in the World Economy

By Charles L. Kimbell [1] and George A. Morgan [2]

Following the 1975 slump in almost every aspect of its activities, the world mineral industry showed strong signs of recovery in 1976, in keeping with the general improvement in overall levels of world industrial and commercial activity, particularly among market economy countries. Indexes and other measures of mineral industry activities reflect substantial growth in 1976, which was most pronounced among the market economy countries. The centrally planned economy countries, far less severely affected by the 1975 slump, continued to show growth but at a lower rate generally, more in keeping with their 1975 progress, while market economy countries combined recovery from 1975 with new growth to achieve record highs in some aspects of their activities.

PRODUCTION

The estimated value of world crude mineral production in 1976 was $190,600 million in terms of constant 1973 dollars, about 5.1% above the revised 1975 level of $181,400 million. This increase in value, however, exceeded the actual quantitative increase in output, because most mineral commodities had higher unit values in terms of constant dollars in 1976 than in 1975.

The following tabulation gives approximate data on the value of world mineral production for selected years in the period 1950–76, in billion constant 1973 dollars. These figures undervalue the role of the mineral industry in the world economy, for they represent an approximation of the value of minerals in their crudest form—the actual production of a mine—and not the enhanced value that results from beneficiation, smelting, refining, and other downstream processing, as well as the value added in transporting much of these mineral materials from the nations where they are produced in crude form to the nations where they are ultimately consumed. If the value added through processing and through manufacturing basic materials such as cement and fertilizers were included, a

Year	Value of 53 [1] major crude mineral commodities [2]	Value of all crude mineral commodities [3]
1950	$46.2	$52.6
1953	60.3	69.3
1958	77.4	93.0
1963	85.6	104.9
1968	99.2	120.2
1973	159.2	179.8
1974	162.0	r 183.0
1975	r 160.6	r 181.4
1976	169.0	190.9

r Revised.

[1] The list of commodities included appears in table 5 of the 1974 edition of this chapter; one commodity, beryl, covered for 1950–68 is excluded from the 1973–76 figures, but the overall impact of this omission is regarded as insignificant.

[2] Data for all years except 1974–76 are as reported in the Annales des Mines, December 1975, p. 13; data for 1974–76 are extrapolated from the 1973 Annales des Mines figures on the basis of the United Nations index of extractive industry production as given in: United Nations. Monthly Bulletin of Statistics, New York. V. 31, No. 8, August 1977, p. xii.

[3] Data were extrapolated from those values given for the 53 commodities to compensate for commodities not included in the source of that data. For details on the basis of this extrapolation, see relevant text in the 1974 edition of this chapter under "Value of World Mineral Production."

[1] Supervisory physical scientist, Geographic Statistics, International Data and Analysis.
[2] Physical scientist, Division of Ferrous Metals.

1976 figure on the order of $480 billion could be regarded as a conservative estimate of the value of output of primary mineral processing plants. Moreover, it should be noted that crude and processed mineral commodities constitute the overwhelmingly dominant share of the total raw materials base for all manufacturing endeavors, as well as a significant requirement for the agricultural industries because they include fertilizers.

PRODUCTION INDEX PATTERNS

United Nations indexes (1970=100) of the value of mineral industry production of the world (excluding the centrally planned economy nations of Asia) are given in table 1, together with indexes for major sectors of the industry and for overall industrial production. All figures are provided for the world aggregate and for major geographic and economic areas.

The index of the value of output of the extractive industry as a whole registered a 5.2% increase between 1975 and 1976; adjustments made in this index yield a revised decline of 0.9% between 1974 and 1975.

The index of the value of output of the world coal industry increased 1.0% between 1975 and 1976. This was not as large an increase as that recorded for total extractive industry output. The crude petroleum and natural gas sector world index advanced 7.4% between 1975 and 1976, in sharp contrast to the 2.4% decline (revised) suffered between 1974 and 1975. The metal mining sector world index registered a 2.9% increase between 1975 and 1976, in contrast to the 4.6% decline between 1974 and 1975.

A considerable disparity continued to exist between indexes of various world regions, but in distinct contrast to the situation between 1974 and 1975 when the centrally planned economy countries showed gains and the market economy countries mainly recorded declines, the changes between 1975 and 1976 favored the market economies which, as a group, showed greater increases in indexes of metals and oil output value as well as of total extractive output value than those of the centrally planned economies. Only in the case of coal did the centrally planned economies record a higher growth rate than that of the market economies.

It is notable, however, that if a comparison is made between the indexes for 1974 and 1976, the market economies recorded only very modest growth (as a result of the 1975 slump), while the centrally planned economies showed substantial gains. Furthermore, the various groups of market economy countries detailed in table 1 showed divergent patterns of change in their indexes, differing substantially, in some cases, from the average for the group as a whole in 1976 as well as in preceding years.

As with the extractive industry indexes, there were widely varying changes in the mineral processing industry indexes covered in table 1. The base metals index for the world showed an 8.0% growth between 1975 and 1976, but this just compensated for the decline between 1974 and 1975, with the result that the 1976 index was on a par with that for 1974. In the case of chemicals and petroleum and coal products, the 1976 index was 10.6% above the 1975 level and 9.0% above the 1974 level, but the growth here was more a function of rising unit prices than of increased output volume. The worldwide index for nonmetallic mineral products, which was unchanged between 1974 and 1975, advanced 7.1% in 1976. Generally, processing industry index trends followed those of extractive industry on a geographic basis, but there were some exceptions that are evident upon detailed examination of table 1.

QUANTITATIVE WORLD MINERAL PRODUCTION

Total world production of 81 mineral commodities is given for the years 1974–76 in table 2. Regional distribution of these same commodities for 1976 is given by major geographic area in table 3 and by economic group of nations in table 4. In addition, tables 34–56 give world output of selected individual major commodities by principal producing country for 1974–76.

The most prominent aspect of the data in table 2 is the great number of commodities for which production increases were registered between 1975 and 1976; of the 81 commodities listed, 59 (almost 75%) showed gains, with only 22 registering losses. This is a reversal of the pattern be-

tween 1974 and 1975, when 58 commodities registered declines, 22 registered increases, and 1 was unchanged (revised).

Metals.—Of the 41 metallic mineral commodities listed in table 2, 31 registered production increases between 1975 and 1976 and 10 showed declines; this is in contrast to the pattern between 1974 and 1975, when 30 recorded declines and only 11 showed increases (revised). Among major metals, aluminum, copper, smelter lead, zinc, and the metallic forms of iron registered increases in 1976, while iron ore and mine lead recorded declines.

Nonmetals.—Among the 29 nonmetallic mineral commodities shown in table 2, 19 showed increases between 1975 and 1976 and 10 recorded declines, in contrast to 6 up, 22 down, and 1 unchanged between 1974 and 1975. Among major nonmetals, output of cement, gypsum, lime, and salt, all of which declined between 1974 and 1975, showed increases between 1975 and 1976. Nitrogenous fertilizers recorded increases both years, while phosphate rock and sulfur declined both years.

Mineral Fuels.—In 1976, world production of energy from all commercial sources (excludes wood, charcoal, bagasse, and animal dung, which are regarded as noncommercial sources) reached a new record high, totaling 8,951 million tons of standard coal equivalent (SCE), 5.5% above the revised 1975 level of 8,482 million tons SCE and more than 4.8% above the revised 1974 level of 8,537 million tons SCE, the previous record high. The percentage distribution of energy production, by fuel source, is given in the following tabulation for 1974–76:[3]

Source	1974	1975	1976
Coal (including lignite)	2^.3	r 31.0	30.2
Petroleum	r 49.8	r 47.7	48.7
Natural gas	r 18.5	r 18.7	18.6
Hydro, geothermal, and nuclear electricity	2.4	2.6	2.5

r Revised.

All primary energy forms registered quantitative gains in production in 1976, and petroleum recovered some of the ground lost in 1975 to coal, natural gas, and primary electricity in terms of percentage of total.

Of the 11 mineral fuel commodities reported in table 2, 9 showed increases between 1975 and 1976 while 2 registered declines. Carbon black, coal (all types), metallurgical coke, natural gas, natural gas liquids, and crude and refined oil output increased, while low-temperature coke and peat output declined.

VALUE OF WORLD MINERAL PRODUCTION

General estimations regarding total world mineral output value in 1974–76 appear in the first paragraphs of the "Production" section and in the tabulation that accompanies them; no data are provided in this chapter on the value of world mineral production on a country or commodity basis. The source for this information, the French mineral industry publication *Annales des Mines,* publishes only on a 5-year cycle in this detail, the last year covered being 1973. For information on the 1973 distribution of world mineral output value by commodity and country and details on the methods used to extrapolate this data in aggregate to the present, the reader is referred to the corresponding section of the 1974 edition of this chapter.

TRADE

GENERAL TRENDS

In 1975, the value of total world trade in mineral commodities declined to $311,136 million from a record high of $320,612 million (revised) in 1974. This is the first time in recent years that a decline has occurred and represents the end of the commodity price boom that began at the end of 1973 when world crude petroleum prices were drastically increased. The value decline of nearly 3% compares with a more than 110% increase (revised) between 1973 and 1974. The value of world mineral commodity trade as a percentage of the value

[3] Based on: United Nations. World Energy Supplies 1972–76, New York. Statistical Papers, ser. J, No. 21, 1978, p. 2.

of world trade in all commodities declined from 38.5% (revised) in 1974 to 35.7% in 1975. This was owing not only to the decline in mineral commodities traded but also to the increase in the value of other commodities traded. Prices in a given mineral commodity eventually work their way up through the various stages of upgrading and processing, with the result that end product use reflects such added value at a later date. Thus, products of the manufacturing, processing, and chemical industries, which account for the bulk of all nonmineral commodities, increased in value while mineral commodity prices leveled off or declined. The following tabulation gives data for 5 years on the value of world trade in mineral commodities:

	Value of mineral commodities traded [1] (millions)	Percent change from previous year	Percent of total value of all commodities traded
1971	r $91,191	+9.1	r 26.3
1972 r	104,328	+14.4	25.2
1973 r	152,345	+46.0	26.5
1974 r	320,612	+110.5	38.5
1975	311,136	−3.0	35.7

r Revised.
[1] Value estimated from data on mineral commodities appearing in table 5, to which has been added a factor for all mineral commodities not included in that table. The factor added is based on a comparison of complete mineral trade value returns for selected countries with data given for these same countries in the source of table 5, which includes only the selected mineral commodity groups specified in the footnotes to that table. This comparison indicates that reported mineral commodity trade as listed in table 5 represents about 81.5% of total mineral commodity trade.

The shares of both developed and developing market economy countries in world trade in major mineral commodities declined in 1975, while that of centrally planned economy countries increased to 9.6% from 6.8% in 1974.

COMMODITY GROUP TRADE PATTERNS

The value of world export trade in major mineral commodity groups and in all commodities for 1971–75 is given in table 5. The percentage distribution of the world export value among the major mineral commodity groups is given in table 6, while table 7 gives the growth in value of export trade in each of the major mineral commodity groups over the 5-year period, as well as the growth in value of all commodities traded. The world export value of two of the five major mineral commodity groups increased slightly in 1975. Crude nonmetals and mineral fuels together were up by $857 million. However, metal ores, concentrates, and scrap, iron and steel, and nonferrous metals all were down, declining a total of $8,580 million. The sharpest decline in value of world trade was experienced by the nonferrous metals group, which fell 27.7% or $6,978 million. Its share of total major mineral commodity world trade continued to decline, falling to 7.2%. Despite the 1.3% decline in value of trade in iron and steel, that group's share of total major mineral commodity world trade increased slightly to 18.1% from 17.8% (revised) in 1974. The portion of trade in metal ores, concentrates, and scrap continued to decline, falling to a record low of 5.8%. The value of all metals trade declined 9.8%, following 2 years of 43% and 54% increases. Mineral fuels, which reached a record high world trade value of $168,560 million in 1975, experienced a growth rate of only 0.3% compared with 110.5% the previous year. However, that group's share of total major mineral commodity world trade increased again to 66.5% from 64.3% in 1974. In the 5-year period beginning in 1971, the value of all commodities traded has increased 152% or $526,257 million. However, owing to the reduction in the growth rate of the mineral fuel trade value, which value accounted for 19% of all commodities traded in 1975, the growth rate of the world export trade value in all commodities also dropped considerably, falling to 4.7% from 45.1% the previous year. In comparison with the 152% increase in the value of all commodities traded in the 1971–75 period, the total value of world export trade in major mineral commodity groups increased 241%.

REGIONAL TRADE PATTERNS

The significance and direction of world trade in major mineral commodity groups,

by value, is provided in a series of three tables. Table 8 gives the aggregate of the five major mineral commodity groups in terms of exports from and exports to major areas and countries, along with comparable data on the value of all commodities traded. Table 9 shows the direction by source and destination of aggregated major mineral commodity trade, and table 10 gives a breakdown by major mineral commodity group of the aggregate listed in table 8. The following tabulation represents a synthesis of the data available on world export trade in major mineral commodities in 1975, in terms of value and percentage of the world total by major trading areas:[4]

Destination	Source				
	Market economy countries		Centrally planned economy countries	Unspecified [1]	Total
	Developed	Developing			
Value (million dollars):					
Market economy countries:					
Developed	66,878	104,719	10,777	1	182,375
Developing	16,226	27,921	1,699	—3	45,843
Centrally planned economy countries	7,102	2,501	11,581	—1	21,183
Unspecified	2,451	1,573	147	4	4,175
Total	92,657	136,714	24,204	1	253,576
Percentage of world total:					
Market economy countries:					
Developed	26.4	41.3	4.2	(2)	71.9
Developing	6.4	11.0	.7	(2)	18.1
Centrally planned economy countries	2.8	1.0	4.6	(2)	8.4
Unspecified	1.0	.6	(2)	(2)	1.6
Total	36.6	53.9	9.5	(2)	100.0

[1] Figures represent the difference between reported totals and reported detail. Explanations for negative quantities are not provided in source publication.
[2] Less than ½ unit.

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 30, No. 8, August 1976, pp. xxvii–xlv; and V. 31, No. 5, May 1977, pp. xxviii–lii.

As in 1974, the value of major mineral commodity exports from developing nations exceeded that for developed nations, although it made up a lower percentage of the world total than in 1974. Of the total value of major mineral commodities traded, 53.9% was from developing market economy countries, compared with 36.6% from developed market economy countries. The value of exports from centrally planned economy countries increased to 9.5% of the world total, rising by $6,194 million over that of 1974. Significantly, in this time period, centrally planned economy trade patterns reflected the downturn in market economies. Exports from centrally planned economies to developed market economies rose by only $1,478 million, compared with those to centrally planned economies which jumped 68% from $6,905 million in 1974 to $11,581 million in 1975. Exports from developed market economies to centrally planned economies also increased in 1975, rising by $1,201 million compared with those to developed market economies, which declined by $5,392 million.

Among the areas and countries listed in table 8, the developing market economies of Africa, the Near East, and Latin America were the most heavily affected by the slump of 1975, with the value of exports from these areas declining appreciably, both on a percentage basis and in terms of actual value. Developed market economies of North America and Europe experienced more gradual changes in the value of materials imported and exported. In absolute terms, the value of major mineral commodity exports from Canada and the United States actually increased slightly, but its share of all commodities exported declined

[4] Countries are grouped according to United Nations practice: Developed market economy countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, West Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, the Republic of South Africa, Spain, Sweden, Switzerland, the United Kingdom, the United States, and Yugoslavia; centrally planned economy countries are Albania, Bulgaria, the People's Republic of China, Czechoslovakia, East Germany, Hungary, North Korea, Mongolia, Poland, Romania, the U.S.S.R., and Vietnam; and developing market economy countries are all other countries.

from 15.9% to 15.1%. The European Economic Community (EEC), whose exports of all commodities account for about one-third of the total value of world trade, experienced declines in both exports and imports of major mineral commodities. The most severe decline was in nonferrous metals, with exports dropping by $2,062 million and imports dropping by $3,292 million, the latter reflecting recessionary trends in the housing construction and automotive industries.

Centrally planned economies of Europe experienced increases in the value of trade in each of the major mineral commodity groups except exports of nonferrous metals, which declined by $279 million. Particularly acute was the jump in value of mineral fuels imported by that region, almost double the 1974 high of $3,880 million. The mineral fuel export value increased sharply as well, most going to countries within that political-economic block. The downturn in trade of market economies, while appearing to enhance the position of centrally planned economies with regard to world trade, was highly disruptive of exports and imports of developing market economies. The total value of exports of major mineral commodities to Latin America from the world fell to $17,189 million in 1975 from a total of $19,545 million in 1974. The total value of exports of major mineral commodity groups from Australia and New Zealand was up by $611 million in 1975. The value of mineral exports from these two countries increased to nearly every area of the world; exceptions were the United States, the European Free Trade Association (EFTA), market economy Far East and South Asia other than Japan, and Australia and New Zealand themselves.

CONSUMPTION

NONFUEL MINERAL COMMODITIES

After a sharp downturn in consumption levels for most major nonfuel mineral commodities in 1975, there was a pronounced upturn in 1976. Available information on world consumption of major commodities for 1976 indicates that some commodities reached new highs in that year (topping previous peaks of 1973 and 1974) and that others, while not setting new records, recorded substantial recoveries from 1975 levels.

World consumption (selected major countries) of iron ore was up 3.2% in 1976, as indicated in table 11, and that of iron and steel scrap advanced 6.9%, as shown in table 12. These tables present 1974–76 figures for a number of nations that report consumption levels for these materials.

The upturn in consumption of nonferrous metals is reflected in the figures presented for aluminum, copper, lead, tin, and zinc in table 13; each of these metals was used in greater quantities in 1976 than in 1975. The use of aluminum and copper topped the 1974 levels, with the former reaching a new high and the latter falling only slightly short of the 1973 record high.

Among major nonmetallic minerals, sulfur showed increasing use among market economy countries in 1976, with a 3.6% increase over the revised 1975 figure to 31.5 million tons; a growth of at least that magnitude on a percentage basis almost assuredly occurred among the centrally planned economy countries. All fertilizer commodities registered growth between the 1975–76 and 1976–77 crop years (those beginning July 1). Nitrogenous fertilizer use advanced 3.5% over the revised 1975 figure to 44.5 million tons (nitrogen content basis), phosphatic fertilizer consumption was up 5.6% over the revised 1975 figure to 26.6 million tons (P_2O_5 basis), and potassic fertilizer use increased 9.9% over the revised 1975 figure to 23.3 million tons (K_2O equivalent basis).

MINERAL FUEL COMMODITIES

World consumption of energy, by energy source, is given in table 14 for the 6-year period 1971–76 in terms of SCE. Total world energy consumption advanced 5.6% between 1975 and 1976, compared with an increase of less than 0.8% between 1974 and 1975. On a per capita basis, the 1975–76 growth was 3.7%, compared with a decline of 1.0% between 1974 and 1975.

From the viewpoint of sources of energy, liquid fuels again dominated, accounting for 44.9% of the 1976 total, followed by

solid fuels (32.4%), natural and imported gas (20.0%), and hydro, nuclear, and imported electricity (2.7%). All sources showed growth between 1975 and 1976, but the growth as contributed to by both the various sources and the various regions was far from uniform throughout the world. A comparison of energy sources by region as presented in table 14 shows a wide variety of rates of growth between 1975 and 1976.

INVESTMENT

Available information on investment in selected industrial sectors of market economy countries and total U.S. mineral industry investment, together with general indications and spot reporting of individual investments in other world areas, indicate a general upturn in investment levels in 1976. Although official 1976 results were not available at this writing, it seemed evident that the decline of 10% from 1974 to 1975 in aggregated annual investment expenditures in the steel industries of selected major market economy countries (see table 15) did not extend into 1976—rather that an upturn occurred. Investment in the petroleum industries of market economy countries advanced in 1976, as shown in table 16, which details capital and exploration expenditures by geographical area. The overall increase in petroleum industry investment was nearly 14.1% between 1975 and 1976 (compared with 13.2% between 1974 and 1975). The percentage distribution of total petroleum industry investment by geographic area, was as follows, based on data from the Chase Manhattan Bank:

Area	1975	1976
United States	36.4	39.6
Other Western Hemisphere	11.8	11.8
Western Europe	18.0	15.6
Africa	3.6	4.4
Near East	4.0	8.0
Far East	8.8	6.4
Unspecified	17.4	14.2

It is noteworthy that of the total investment, a slightly smaller share was directed to exploration expenses in 1976 than in 1975 (see table 16); most of the increase was in the areas of production facilities for crude oil, natural gas, and natural gas liquids, as can be seen in table 17, which details capital investments by industry sector.

Table 18 summarizes U.S. direct foreign investment in the mineral industry in 1973–76, providing information on value, earnings, and income in the fields of mining, smelting, and refining, and petroleum, with a 1975 and 1976 breakdown by geographic area and country. The total value of U.S. direct foreign investment in mining, smelting, and refining in 1976 was 7.8% higher than in 1975, and that in petroleum was 13.4% higher. The growth patterns of geographic areas are varied as can be seen in table 18.

TRANSPORTATION

MARINE TRANSPORT

Tankers, bulk carriers, and freighters are the primary oceangoing vessels for transport of mineral commodities. The number, gross tonnage, and deadweight tonnage of these vessels, as reported by the U.S. Maritime Administration for 1972–76, are given in table 19. The data listed therein for 1975 and 1976 are not completely comparable to those supplied for previous years owing to the inclusion of refrigerated freighters in the "Freighter" category in 1975 and 1976 and in the "Other" category in 1972–74. Such vessels numbered approximately 1,000 in 1974, with a combined gross tonnage of 5,433,000 tons and a combined deadweight tonnage of 5,794,000 tons. It must be remembered that vessels in each of the categories listed may not be involved wholly or even partly in transport of mineral commodities. Tankers generally move petroleum and refinery products, but the category also includes wine, molasses, and whaling tankers. Bulk carriers move agricultural products in addition to fertilizer and crude minerals, while freighters, because of their highly evolved technical nature, move numerous and diverse materials.

The percentage of world shipping that is mineral related is indicated by an exam-

ination of traffic transiting the Panama and Suez Canals. In 1976, 55.5% of all Panama Canal traffic and 55.6% of all Suez Canal traffic was of mineral commodities. Considering that most tanker and bulk carrier traffic bypasses the canals because of capacity limitations, it is clear that an even larger percentage of total seaborne traffic is mineral related.

The total merchant fleet amounted to 23,586 vessels in 1976, with a combined gross tonnage of 358,203,000 tons and a combined deadweight tonnage of 606,499,000 tons. The number of vessels increased 3.1%, gross tonnage 7.6%, and deadweight tonnage 9.0% over the 1975 figures. The slight change in the number of vessels in the fleet compared with the larger increases in gross weight and deaweight tonnages illustrates the increase in the average size of the vessels. With a net addition of 714 vessels, 49,927,000 deadweight tons was added to the fleet, 67% of which was in tankers.

The volume of transport in the 5-year period 1972–76, in terms of loadings and unloadings of tanker and dry cargo, is given in table 20. Overall, loadings of tanker cargo increased 9.3% in 1976, while unloadings were down 2.8%. Loadings of dry cargo were up 8.1%, and unloadings increased 16.0%. In the case of tanker loadings, the 1976 upturn followed two consecutive years of decline, while in the case of dry cargo loadings, the 1976 level was a new record high, exceeding the previous high of 1974.

Tables 21 and 22 give a regional breakdown of such loadings and unloadings, by cargo type. Loadings of tanker cargo by developed market economy countries were unchanged in 1976. An examination of their unloadings indicates a 4.6% decline. Most of the decline was the result of a 12.5% decline in the Western European countries; modest gains in the United States and Japan partly offset this drop. Tanker loadings by developing countries, which include the Near East and northern Africa, increased nearly 10.5%, only partly compensating for the 12.1% decline (revised) registered between 1974 and 1975 and still well below the 1973 record level. Unloadings by developing countries followed the 1975 decline of 9.5% with a 3.7% increase in 1976. Loadings of tanker cargo advanced 7.9% for centrally planned economy countries, and unloadings were up 13.8%. Loadings of dry cargo increased to new highs for all three groups. Unloadings of dry cargo by developed market economies recovered from the slump of 1975 to reach a new high, while unloadings by developing market economies and centrally planned economies also reached new highs, continuing unabated growth. The United States recorded a 38.0% increase between 1975 and 1976.

Tankers.—In 1976, the world tanker fleet increased by only 72 vessels (or 1.4%), compared with an increase of 190 vessels between 1974 and 1975. The additional vessels, however, resulted in an 11.0% increase in deadweight tonnage. Average tanker size increased once again, reaching 62,344 deadweight tons compared with 56,904 deadweight tons (revised) in 1975. Table 23 gives the distribution of world oil tanker tonnage, by size group, for 1976, with 1966 data included for comparison. In that 10-year period, total world oil tanker deadweight tonnage increased 223%. The dramatic change in the composition of the fleet is evident from a comparison of the percentage of vessels of 125,000 deadweight tons and over for the two years. In 1966, only 1.1% was of that size group, compared with 62.8% in 1976. As in 1975, tankers in the 205,000- to 285,000-ton group accounted for the largest percentage (43.2% in both years) of tankers afloat, However, only 20.2% of new tankers under construction or on order at yearend were in this class, compared with 29.6% at yearend 1975. Of the vessels under construction or on order at yearend 1976, 38.4% were to be 285,000 tons and over. The total tonnage of vessels under construction or on order at yearend 1976 was 35.2 million tons, compared with 88.5 million tons a year earlier, a decline of 60.2%. By yearend 1976, 60.8% of the total world tanker tonnage had been added during the past 6 years. The following tabulation gives a percentage breakdown of total tonnage, in terms of year of completion, of vessels classified as tankers in 1975 and 1976:

Year of completion	1975	1976
Through yearend 1950	1.4	1.1
1951–55	2.7	1.8
1956–60	8.8	6.6
1961–65	11.3	9.4
1966–70	22.5	20.3
1971–75	53.3	48.2
1976	--	12.6

Source: British Petroleum Co. Ltd. BP Statistical Review of the World Oil Industry. Bayard Press, London, 1975 and 1976.

Liberia remained the leading country of registry of vessels classified as tankers, with an increase of 11,762,000 tons over the 1975 tonnage. The following tabulation distributes the world tanker fleet by flag of registry, in order of total national deadweight tonnage, in 1976:

Country	Number of vessels	Deadweight tonnage (thousand tons)
Liberia	1,004	101,232
Japan	550	36,051
United Kingdom	424	32,877
Norway	337	30,743
Greece	329	16,403
France	154	15,335
Panama	227	10,895
United States	269	10,714
Italy	230	8,880
Sweden	90	7,685
Germany, West	89	6,930
U.S.S.R	487	6,740
Spain	119	6,258
Singapore	94	5,542
Denmark	70	5,285
Other	910	34,030
Total	5,383	335,600

Bulk Carriers.—In 1976, the world bulk carrier fleet increased by 298 vessels (or 7.0%), compared with an increase of 197 vessels in 1975. Deadweight tonnage was up 8.8%, compared with 7.8% in 1975. The average size of all bulk carriers increased from 35,131 deadweight tons in 1975 to 35,733 deadweight tons in 1976. The following tabulation lists the leading countries with bulk carrier fleets in 1976, in order of total deadweight tonnage:

Country	Number of vessels	Deadweight tonnage (thousand tons)
Liberia	990	40,464
Japan	572	23,185
Norway	310	17,094
Greece	546	15,013
United Kingdom	346	14,853
Italy	155	6,962
Panama	255	5,455
Sweden	88	4,673
Germany, West	77	4,012
India	88	3,782
France	60	2,735
U.S.S.R	166	2,026
Spain	64	1,979
Poland	78	1,830
Singapore	49	1,779
Brazil	37	1,578
Other	689	15,878
Total	4,570	163,298

Freighters.—The world freighter fleet (including refrigerated freighters) amounted to 12,923 vessels in 1976. Advances in technology and application of these advances in shipyard construction have led to an extremely varied class of vessels. Freighters consist of general cargo carriers, full containerships, partial containerships, roll-on/roll-off vessels, and the newest design, barge carriers. The U.S. freighter fleet alone can not be considered solely in terms of numbers of vessels, because numerous war-built vessels have been scrapped, with a resultant decline in the number of vessels over the past 10 years. The average vessel age of the U.S. fleet has declined since 1968, with newer vessels having nearly a 20% increase in average speed and a 40% increase in average deadweight tonnage. Because of the inseparability of refrigerated freighters from the class of freighters, the overall statistics are not readily comparable to previous years' data. The following tabulation lists the leading nations in registry of freighters in 1976, in order of total deadweight tonnage:

Country	Number of vessels	Deadweight tonnage (thousand tons)
U.S.S.R	1,771	10,967
Greece	984	9,289
Panama	1,126	8,079
Japan	920	7,348
United Kingdom	716	7,050
Liberia	613	6,247
United States	299	4,931
Germany, West	461	3,912
Cyprus	451	3,009
China, People's Republic of	298	2,686
Netherlands	342	2,506
Norway	294	2,399
Other	4,648	36,216
Total	12,923	104,639

OCEAN FREIGHT RATES

Following sharp downturns in freight rates for all categories between 1974 and 1975, there were several upturns in 1976. Many categories, however, continued to decline, as can be seen in table 24, which provides considerable detail for 1973–76.

PANAMA AND SUEZ CANALS

The number of transits and quantity of cargo moved through the Panama Canal decreased 10.7% and 16.3%, respectively, in fiscal year (the year ending June 30 of that stated) 1976. The quantity declined by 31,188,000 tons from the record tonnage set

in 1974 to 119,093,000 tons. Significantly, the quantity of mineral commodities moved through the canal declined 26.2%, a greater percentage decrease than that for all commodities, which indicates that the share of mineral commodities in the total tonnage dropped. The following tabulation summarizes mineral commodity movement in comparison with other Panama Canal activity for fiscal years 1974–76:

	1974	1975	1976
Number of transits:			
Commercial ocean traffic	14,033	13,609	12,157
Other traffic	1,236	1,126	1,044
Total	15,269	14,735	13,201
Cargo moved (thousand metric tons):			
Commercial ocean traffic:			
Mineral commodities	87,696	89,250	65,861
Other commodities	62,585	53,100	53,233
Subtotal	150,281	142,350	119,094
Other traffic	1,801	543	193
Total	152,082	142,893	119,287

Modifications in the type and nature of vessels transiting the Panama Canal were again evident in 1976. While transits and tonnage were down, average ship size continued to increase. The trend continued toward replacement of smaller vessels in canal trade by larger specialized vessels, primarily bulk carriers and containerships. Table 25 gives commercial ocean traffic through the Panama Canal in terms of number of transits and cargo moved, by vessel type, for fiscal years 1975 and 1976. In terms of cargo weight, dry bulk carriers accounted for 55.4% of the total moved in 1976, followed by tankers at 19.9% and general cargo ships at 13.1%. Over 56% of the total cargo moved through the canal was Pacific bound, again with dry bulk carriers and tankers making up most of the tonnage. In terms of the number of transits, dry bulk carriers led all other classes with 28.2%, followed closely by general cargo ships with 26.5%.

Table 26 gives 3 years' data on the quantity of individual mineral commodities shipped through the Panama Canal, by direction of movement. Over 61% of the tonnage moved in fiscal year 1976 was Pacific bound. Coal and coke topped all other mineral commodities in terms of tonnage moved, accounting for 25.8% of the total, followed by crude petroleum with 18.4%, refinery products with 15.4%, and iron and steel semimanufactures with 11.8%. The tonnage of crude petroleum and refinery products moved was down 8.3% from that of 1975.

In its first full year of commercial operations since its closure during the 1967 Arab-Israeli conflict, the Suez Canal in 1976 recorded 16,806 vessel transits (all classes of vessels, both in ballast and laden), carrying 117.6 million tons of cargo of all types. This traffic, and the role of mineral commodities in it, is summarized in the following tabulation:

	1975 r 1	1976
Number of transits:		
Commercial ocean traffic	5,495	16,402
Other traffic	84	404
Total	5,579	16,806
Cargo moved: Commercial ocean traffic (thousand metric tons):		
Mineral commodities	16,684	105,203
Other commodities	20,935	12,440
Total	37,619	117,643

r Revised.
1 Data are for June 5 through Dec. 31, 1975.

Table 27 provides details on the type and number of commercial ocean traffic vessels transiting the Suez Canal since its reopening, by status (in ballast or laden) and direction of movement. Table 28 details tonnages of mineral commodities moved for the same time period, by direction of movement. Crude oil accounted for 37.2% of total 1976 mineral commodity movement and petroleum refinery products for an ad-

ditional 15.1%; this was despite limitations on the size of vessels transiting the canal and the substantial increase in the average size of tankers that took place between the time of the canal's closure in 1967 and its reopening in 1975. Other mineral commodities accounting for significant shares of total mineral commodity shipments included fertilizers (all types) with 10.5%, iron ore with 6.3%, and cement with 5.9%.

PIPELINES

Limitations of space and time do not permit an overall appraisal of worldwide pipeline construction activity in this chapter. In the most general terms, however, it is clear that construction activity was intensified over 1975 levels in most world areas. Newsworthy pipelines under construction included the crude oil line linking Alaska with mainland United States and the gasline links between the Norwegian North Sea fields and West Germany, which were nearing completion at yearend. Algeria, a member of the Organization of Petroleum Exporting Countries (OPEC), recorded the completion of four lines, each over 300 miles long—two carrying natural gas from Hassi R'Mel, one to Arzew and the other to Skikda; and two carrying crude oil from Haoud el Hamra, one to Arzew and the other to Skikda. Other OPEC completions included a 460-mile refinery products line in Iran from Ahwaz to Rey and several shorter refinery products lines and one gasline, also in Iran.

PRICES

Comprehensive data on world mineral commodity prices are not available, but some idea of the general upward trend in prices in market economy countries can be obtained from tables 29 through 31, which give recent annual average prices, as well as monthly 1976 averages, for major nonferrous metals for Canada, the United States, and the United Kingdom. Figures presented for aluminum show a moderate upward trend during 1976, reflecting the rising costs of energy required for the reduction of this metal from alumina. In the case of copper, prices in all three areas advanced for the first 7 to 9 months then declined to lose most of their gains by yearend, but the annual average price for 1976 was, in each case, significantly above the 1975 annual average. Lead prices in each of the three areas advanced during 1976 to average well over the 1975 annual average, but in contrast, zinc prices were lower in the United States and United Kingdom and only slightly above that of 1975 in Canada. The tin price on both the New York and London markets fluctuated throughout 1976 but ended the year considerably ahead of the 1975 average; the annual average was also above the 1975 average. The annual average silver price declined from 1975 to 1976, although at midyear on all three markets the price well exceeded the 1975 average and approached the monthly highs set in August 1975.

United Nations data on world mineral commodity export prices are presented in the form of indexes in tables 32 and 33. Unfortunately, results for 1976 were not complete, but the general upward trend through the first three quarters of 1976 is evident in the tables.

STATISTICAL SUMMARY OF WORLD PRODUCTION AND TRADE OF MAJOR MINERAL COMMODITIES

The final 36 tables of this chapter (tables 34 through 69) extend the statistical series that was started in Volume III of the 1963 Minerals Yearbook and was subsequently updated and expanded in the 1965 and 1967–75 editions. They are primarily a supplement to other statistical data within this chapter but also serve as a summary of international production and trade data for major mineral commodities covered in greater detail on a commodity basis in Volume I of the 1976 Minerals Yearbook and on a country basis in the balance of Volume III.

The data presented here on production (tables 34 through 56) in most instances correspond directly to the data in the individual commodity world production

tables appearing in Volume I and as such may not correspond exactly to figures presented in the individual country chapters of Volume III. Such differences are usually the result of the receipt of revised data for inclusion in either a commodity chapter or a country chapter subsequent to the completion of the other chapter. In most cases, country chapters were prepared later than commodity chapters and should be regarded as more reliable.

The data presented on world trade (tables 57 through 69) may not correspond exactly to those presented elsewhere in Volume III because these summary tables are compiled, at least in part, from sources other than those used in the individual country chapters in order to obtain data on a consistent basis. The differences, however, are regarded as unimportant from the viewpoint of indicating the general pattern of trade in these commodities.

The format of table 66 (showing world solid fuel trade) has been modified to make it parallel in structure to table 69 (refined petroleum trade). The modification, which eliminates some of the detail previously provided, was necessitated by deletion of this detail in the source publication.

Table 1.—United Nations indexes of the value of world [1] mineral industry production

(1970=100)

Industry sector and geographical area	1974	1975	1976	1976, by quarter			
				First	Second	Third	Fourth
EXTRACTIVE INDUSTRIES							
Metals:							
Market economy countries	r 104	r 98	101	98	101	102	104
Developed [2]	r 100	r 94	96	92	98	98	98
United States and Canada	r 104	r 95	101	94	104	103	102
Europe	r 106	100	98	101	102	90	98
EEC [3]	r 88	83	77	81	80	71	75
EFTA [4]	119	108	110	118	119	96	113
Australia and New Zealand	102	r 104	101	90	97	113	103
Developing [5]	r 111	r 103	109	109	106	109	113
Latin America [6]	r 118	r 108	116	118	109	113	122
Asia [7]	r 95	r 96	99	97	99	98	102
Centrally planned economy countries of Europe [8]	r 119	r 122	123	122	125	123	121
World	r 108	r 103	106	104	107	107	108
Coal:							
Market economy countries	85	88	88	91	88	81	92
Developed	83	r 85	85	88	86	78	89
United States and Canada	102	112	114	114	118	106	119
Europe	76	r 77	76	80	75	68	80
EEC	74	r 74	72	77	72	64	76
EFTA	97	90	91	96	88	89	92
Australia and New Zealand	r 132	r 131	145	134	150	145	151
Developing	r 113	r 122	124	134	121	117	124
Latin America	r 118	r 117	114	NA	NA	NA	NA
Asia	112	125	131	146	126	124	128
Centrally planned economy countries of Europe	110	r 114	116	115	117	116	117
World	96	r 99	100	102	101	96	103
Crude petroleum and natural gas:							
Market economy countries	r 122	r 116	125	122	120	125	132
Developed	112	r 114	114	117	111	110	121
United States and Canada	r 103	r 106	104	104	102	103	107
Europe	r 158	r 159	178	204	157	138	213
EEC	r 164	r 166	187	216	164	142	227
EFTA	NA	NA	NA	NA	NA	NA	NA
Australia and New Zealand	NA	NA	NA	NA	NA	NA	NA
Developing	r 129	117	132	126	126	135	140
Latin America	r 100	r 94	94	99	93	97	89
Asia	r 154	r 138	158	149	148	162	173
Centrally planned economy countries of Europe	130	140	148	141	140	142	136
World	r 124	r 121	130	128	126	130	135
Total extractive industry:							
Market economy countries	112	107	114	111	111	113	119
Developed	r 104	r 102	104	104	103	102	109
United States and Canada	104	r 105	106	105	105	103	106
Europe	r 99	r 95	98	103	96	90	104
EEC	r 97	r 93	96	102	93	86	102
EFTA	111	104	106	109	110	96	107
Australia and New Zealand	144	r 142	144	134	143	150	148
Developing	r 125	r 114	127	122	122	129	134
Latin America	r 108	r 102	104	107	101	104	102
Asia	148	134	152	145	144	155	166
Centrally planned economy countries of Europe	124	r 132	138	136	139	139	136
World	116	r 115	121	118	119	121	124
PROCESSING INDUSTRIES							
Base metals:							
Market economy countries	r 120	r 102	111	107	116	110	112
Developed	118	r 99	107	104	112	105	107
United States and Canada	r 115	92	101	99	109	100	94
Europe	117	r 99	107	106	111	101	111
EEC	112	r 93	101	101	104	96	104
EFTA	116	101	104	101	107	95	112
Australia and New Zealand	111	r 109	109	109	114	111	102
Developing	r 136	r 142	159	141	161	167	167
Latin America	145	r 148	161	139	164	171	169
Asia	121	r 135	164	150	161	172	174
Centrally planned economy countries of Europe	r 126	r 135	146	149	148	145	143
World	121	r 112	121	119	125	120	121

See footnotes at end of table.

Table 1.—United Nations indexes of the value of world [1] mineral industry production —Continued

(1970=100)

Industry sector and geographical area	1974	1975	1976	1976, by quarter			
				First	Second	Third	Fourth
PROCESSING INDUSTRIES—Continued							
Nonmetallic mineral products:							
Market economy countries	121	r 114	124	113	127	126	128
Developed	118	r 109	118	108	122	120	123
United States and Canada	r 120	r 110	124	112	126	129	127
Europe	118	r 109	116	106	122	114	120
EEC	r 116	r 106	113	104	119	110	118
EFTA	119	101	102	93	107	98	110
Australia and New Zealand	r 114	r 116	126	110	128	132	134
Developing	r 139	r 146	158	147	161	168	158
Latin America	r 143	r 151	165	155	166	178	162
Asia	r 135	r 141	152	138	157	156	156
Centrally planned economy countries of Europe	r 135	r 144	152	150	156	153	150
World	126	r 126	135	128	138	137	137
Chemicals and petroleum and coal products:							
Market economy countries	130	r 123	138	134	138	137	143
Developed	r 129	121	137	133	138	135	141
United States and Canada	128	r 125	143	138	143	144	147
Europe	131	r 117	132	131	134	126	136
EEC	r 128	r 113	128	128	131	123	131
EFTA	128	116	127	124	131	117	135
Australia and New Zealand	r 124	r 116	127	117	128	131	132
Developing	r 137	r 136	146	139	144	150	152
Latin America	r 144	r 143	154	NA	NA	NA	NA
Asia	r 125	r 122	130	126	125	133	138
Centrally planned economy countries of Europe	r 146	r 161	175	173	178	176	172
World	r 134	r 132	146	143	147	146	150
OVERALL INDUSTRIAL PRODUCTION							
Market economy countries	121	115	125	122	126	123	130
Developed	119	112	122	119	122	119	126
United States and Canada	119	r 112	124	120	125	124	125
Europe	118	r 111	119	118	120	110	127
EEC	r 115	r 108	116	116	117	107	124
EFTA	119	112	113	112	116	102	123
Australia and New Zealand	r 116	r 117	122	114	122	126	124
Developing	135	r 136	148	139	146	151	155
Latin America	r 141	r 144	154	NA	NA	NA	NA
Asia	r 139	r 140	157	149	152	158	168
Centrally planned economy countries of Europe	140	r 152	164	161	165	164	164
World	126	r 125	136	132	137	134	140

r Revised. NA Not available.

[1] Excludes Albania, the People's Republic of China, North Korea, Mongolia, and Vietnam.

[2] Includes Canada, the United States, all countries of Europe except those listed in footnotes 1 and 8, the Republic of South Africa, Israel, Japan, Australia, and New Zealand.

[3] European Economic Community (EEC) comprises Belgium, Denmark, France, West Germany, Ireland, Italy, Luxembourg, the Netherlands, and the United Kingdom.

[4] European Free Trade Association (EFTA) comprises Austria, Finland, Iceland, Norway, Portugal, Sweden, and Switzerland.

[5] Includes countries not indicated in footnotes 1, 2, and 8.

[6] Corresponds to the United Nations classifications "Caribbean, Central, and South America."

[7] Corresponds to the United Nations classification "Asia, excluding Israel and Japan."

[8] Includes Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and the U.S.S.R.

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 31, No. 8, August 1977, pp. xiv-xxvii.

Table 2.—World production of major mineral commodities [1]

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum:			
Bauxite, gross weight	r 81,477	77,797	79,682
Alumina, gross weight	r 28,558	26,093	26,814
Unalloyed ingot metal	r 13,167	12,108	12,497
Antimony, mine output, metal content ---tons	r 72,088	69,849	69,560
Arsenic, white [2 3] ---do	r 48,959	41,976	36,063
Beryl concentrate, gross weight [2 3] ---do	r 3,184	3,265	2,718
Bismuth [2] ---do	r 4,822	4,000	4,205
Cadmium, smelter ---do	r 17,288	15,373	17,106
Chromite, gross weight [3]	r 7,460	8,233	8,610
Cobalt:			
Mine output, metal content ---tons	r 30,910	29,450	26,114
Refined ---do	r 24,798	20,584	18,360
Columbium-tantalum concentrates [3 4] ---do	r 23,969	15,126	23,055
Copper:			
Mine output, metal content	r 7,297	6,958	7,455
Smelter	r 7,319	7,071	7,408
Refined	r 7,587	7,137	7,547
Gold, mine output, metal content ---thousand troy ounces	r 40,124	38,676	39,883
Iron and steel:			
Iron ore, gross weight	r 897,056	901,551	895,139
Metal:			
Pig iron	r 511,874	480,024	501,386
Ferroalloys	r 12,616	11,915	11,996
Crude steel	r 707,754	646,380	678,811
Lead:			
Mine output, metal content	r 3,416	3,405	3,358
Smelter	r 3,470	3,314	3,438
Magnesium, primary smelter [5] ---tons	r 129,608	125,577	134,761
Manganese ore, gross weight	r 22,456	24,565	24,784
Mercury, mine output, metal content ---tons	r 8,878	8,715	8,419
Molybdenum, mine output, metal content ---do	r 86,812	83,305	87,610
Nickel:			
Mine output, metal content ---do	r 770,234	788,789	804,357
Smelter ---do	r 742,082	723,814	756,760
Platinum-group metals, mine output ---thousand troy ounces	r 5,769	5,714	5,992
Selenium, smelter [3 4] ---tons	r 1,210	1,160	1,257
Silver, mine output, metal content ---thousand troy ounces	r 292,184	297,882	304,899
Tellurium, smelter [3 4] ---tons	r 212	142	[2] 91
Tin:			
Mine output, metal content [2] ---do	r 232,880	221,035	225,755
Smelter ---do	r 236,198	230,576	228,856
Titanium concentrates, gross weight: [3]			
Ilmenite [6]	r 4,039	3,672	4,012
Rutile	r 361	[2] 378	[2] 427
Tungsten, mine output, metal content ---tons	r 37,777	38,194	41,691
Uranium oxide, mine output, U_3O_8 content [3 4] ---do	r 22,333	24,198	27,303
Vanadium, mine output, metal content ---do	r 18,831	21,045	23,543
Zinc:			
Mine output, metal content	r 5,780	5,800	5,866
Smelter	r 5,609	5,074	5,427
NONMETALS			
Asbestos	r 4,158	4,146	5,055
Barite	r 4,644	4,867	4,948
Cement, hydraulic	r 703,213	702,205	736,106
Clays: [3]			
Bentonite [4]	r 4,872	4,727	5,339
Fuller's earth [4]	r 1,504	1,426	1,505
Kaolin	r 16,030	14,505	15,492
Diamond: [3]			
Gem ---thousand carats	r 11,689	10,184	10,320
Industrial ---do	r 32,833	30,924	29,406
Total ---do	44,522	41,108	39,726
Diatomite [3]	r 1,713	1,667	1,735
Feldspar [3]	r 3,011	2,623	2,585
Fluorspar	r 4,863	4,549	4,437
Graphite [2] ---tons	r 493,807	438,204	451,540
Gypsum	r 63,768	60,247	64,271
Lime [3]	r 110,501	103,416	105,806
Magnesite [2]	r 10,054	10,095	9,597
Mica [3]	234	227	214
Nitrogenous fertilizers, N content	r 40,436	42,381	43,876
Phosphate rock	r 110,013	107,381	106,936
Potash, marketable, K_2O equivalent	r 23,794	24,813	24,382
Pumice [3 4]	r 15,348	15,491	15,939
Salt	r 166,276	164,870	167,919

See footnotes at end of table.

Table 2.—World production of major mineral commodities [1]—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS—Continued			
Sodium compounds: [3]			
Sodium carbonate	r 18,597	17,563	17,574
Sodium sulfate	r 2,188	1,940	1,980
Strontium minerals [3 4] ——tons	r 98,958	52,659	57,086
Sulfur, elemental basis:			
Elemental [7]	r 17,769	17,599	16,756
From pyrite	r 10,384	10,110	10,064
Byproduct [8]	r 23,303	23,303	24,054
Total	r 51,456	51,012	50,874
Talc, soapstone, pyrophyllite	r 5,816	4,856	5,367
Vermiculite [3 4] ——tons	r 504,856	525,125	513,521
MINERAL FUELS AND RELATED MATERIALS			
Carbon black [3 4]	r 3,541	3,146	3,506
Coal:			
Anthracite ——million tons	176	178	179
Bituminous ——do	2,126	2,244	2,292
Lignite ——do	834	857	893
Total ——do	3,136	3,279	3,364
Coke:			
Metallurgical	r 367,365	363,287	366,956
Other [9]	r 18,154	17,049	16,489
Gas, natural, marketed ——billion cubic feet	r 47,179	47,364	49,497
Natural gas liquids [3] ——million 42-gallon barrels	r 1,031	1,027	1,048
Peat	r 200,224	203,355	202,353
Petroleum:			
Crude ——million 42-gallon barrels	20,538	19,502	21,192
Refinery products ——do	20,430	19,674	21,270

p Preliminary. r Revised.

[1] Incorporates numerous revisions from world production tables and country production tables appearing in Volumes I and III, respectively, of the Minerals Yearbook and from similar tables in Mineral Trades Notes, as well as from the table corresponding to this table in previous editions of this chapter.

[2] Excludes data for the United States (withheld to avoid disclosing company proprietary data).

[3] Excludes data for the People's Republic of China (no adequate basis for estimation available).

[4] Excludes data for the U.S.S.R. (no adequate basis for estimation available).

[5] Excludes data for the United States (withheld to avoid disclosing company proprietary data), which in previous years accounted for approximately 50% of the total.

[6] Includes titaniferous slag.

[7] Comprises sulfur produced by the Frasch process plus sulfur mined in the elemental state from ores.

[8] Comprises sulfur recovered from coal gasification, metallurgical operations (except pyrite processing), natural gas, petroleum, tar sands, spent oxides, and gypsum, whether recovered in the elemental state or as a sulfur compound.

[9] Data for the People's Republic of China and the U.S.S.R. are included in "Metallurgical."

Table 3.—Geographical distribution of world production of major mineral commodities in 1976

(Percent)

Commodity	Northern North America	Central America and Caribbean Islands	South America	Total Western Hemisphere	Europe	Africa	Near East	Far East	Oceania	Total Eastern Hemisphere
METALS										
Aluminum:										
Bauxite, gross weight	2.5	14.4	10.5	27.4	21.7	15.2	1.4	4.2	30.1	72.6
Alumina, gross weight	23.6	6.1	6.0	35.7	29.5	2.1	.5	9.0	23.2	64.3
Unalloyed ingot metal	36.0	.3	2.2	38.5	43.4	2.8	1.5	10.9	2.9	61.5
Antimony, mine output, metal content	3.7	5.5	22.9	32.1	17.7	17.9	6.2	23.7	2.4	67.9
Arsenic, white [1 2]	NA	11.9	2.3	14.2	63.6	20.0	--	2.2	--	85.8
Beryl concentrate, gross weight [1]	NA	--	23.2	23.2	68.1	8.7	--	--	--	76.8
Bismuth [1]	3.3	14.4	29.3	47.0	7.9	.1	--	28.6	16.4	53.0
Cadmium, smelter	20.5	4.3	1.1	25.9	51.0	2.3	--	16.8	4.0	74.1
Chromite, gross weight	--	.3	2.2	2.5	39.1	37.6	10.5	10.2	.1	97.5
Cobalt:										
Mine output, metal content	4.8	5.7	--	10.5	10.9	50.2	NA	1.8	26.6	89.5
Refined	2.5	--	--	2.5	27.6	67.1	--	2.8	--	97.5
Columbium-tantalum concentrates, gross weight [3]	13.7	--	81.5	95.2	(4)	3.9	--	.4	.5	4.8
Copper:										
Mine output, metal content	29.2	1.2	16.4	46.8	20.6	19.5	.5	7.3	5.3	53.2
Smelter	25.8	1.2	14.2	41.2	24.5	18.5	.5	13.0	2.3	58.8
Gold, mine output, metal content	6.9	1.7	1.8	10.4	21.2	61.1	--	2.8	4.5	89.6
Iron and steel:										
Iron ore, gross weight	15.5	.6	14.3	30.4	39.2	5.8	.5	13.4	10.7	69.6
Metal:										
Pig iron and ferroalloys	17.8	.7	2.2	20.7	49.5	1.5	.6	26.2	1.5	79.3
Crude steel	19.1	.8	2.2	22.1	53.4	1.2	.3	21.9	1.1	77.9
Lead:										
Mine output, metal content	24.3	6.6	7.1	38.0	35.6	4.1	1.1	9.2	12.0	62.0
Smelter	22.2	5.5	4.5	32.2	43.0	3.1	.1	11.7	9.9	67.8
Magnesium, primary smelter [1]	47.1	--	--	47.1	47.9	--	--	5.0	--	52.9
Manganese ore, gross weight	--	1.8	7.2	9.0	36.1	33.7	.3	12.0	8.9	91.0
Mercury, mine output, metal content	9.6	6.3	(4)	15.9	58.4	12.9	1.9	10.9	--	84.1
Molybdenum, mine output, metal content	74.5	(4)	12.8	87.3	10.7	NA	--	2.0	(4)	12.7
Nickel:										
Mine output, metal content	31.1	7.5	.6	39.2	25.3	6.2	--	4.7	24.6	60.8
Smelter	24.3	5.4	.3	30.0	37.3	5.0	--	13.9	13.8	70.0
Platinum-group metals, mine output	7.1	--	.4	7.5	46.8	45.2	--	.5	(4)	92.5
Selenium, smelter [3]	35.9	5.1	2.1	43.1	16.4	NA	--	40.5	NA	56.9
Silver, mine output, metal content	24.2	15.1	16.0	55.3	27.4	3.3	NA	5.4	8.6	44.7
Tellurium, smelter [1 3]	59.1	13.7	--	72.8	NA	NA	--	26.0	1.2	27.2

See footnotes at end of table.

Table 3.—Geographical distribution of world production of major mineral commodities in 1976—Continued

(Percent)

Commodity	Northern North America	Central America and Caribbean Islands	South America	Total Western Hemisphere	Europe	Africa	Near East	Far East	Oceania	Total Eastern Hemisphere
METALS—Continued										
Tin:										
Mine output, metal content [1]	0.1	0.2	16.1	16.4	16.4	6.0	--	56.8	4.4	83.6
Smelter	2.5	.3	7.4	10.2	23.2	2.5	--	61.7	2.4	89.8
Titanium concentrate, gross weight:										
Ilmenite	18.5	--	.5	19.0	39.7	NA	--	10.2	31.1	81.0
Rutile [1]	NA	--	(4)	NA	6.3	NA	--	1.2	92.5	100.0
Tungsten, mine output, metal content	10.4	.6	11.2	22.2	26.9	2.0	2.2	40.8	5.9	77.8
Uranium oxide, mine output, U_3O_8 content [2 3]	64.3	--	.7	65.0	8.9	24.6	NA	NA	1.5	35.0
Vanadium, mine output, metal content	22.8	--	3.7	26.5	37.5	36.0	--	--	--	73.5
Zinc:										
Mine output, metal content	27.5	5.2	9.3	42.0	32.7	4.6	1.9	10.7	8.1	58.0
Smelter	17.2	3.2	2.7	23.1	49.5	3.4	.1	19.4	4.5	76.9
NONMETALS										
Asbestos	32.1	(4)	1.8	33.9	48.7	11.2	.9	4.2	1.1	66.1
Barite	23.8	5.3	8.6	37.7	34.6	4.4	7.0	16.1	.2	62.3
Cement, hydraulic	10.5	2.5	5.1	18.1	51.7	3.2	3.9	22.3	.8	81.9
Clays: [3]										
Bentonite [3]	63.1	1.1	6.2	70.4	18.1	1.7	1.8	7.9	.1	29.6
Fuller's earth [3]	80.7	1.3	.2	82.2	12.5	4.2	--	1.1	(4)	17.8
Kaolin	33.5	.4	3.4	37.3	53.1	1.0	1.3	6.6	.7	62.7
Diamond:										
Gem	--	--	2.5	2.5	21.2	76.1	--	.2	--	97.5
Industrial	--	--	2.4	2.4	27.6	70.0	--	(4)	--	97.6
Diatomite	32.8	1.5	3.8	38.1	60.0	1.1	--	.8	(4)	61.9
Feldspar	25.2	3.5	7.0	35.7	56.1	2.1	--	5.9	.2	64.3
Fluorspar	5.1	22.4	1.6	29.1	40.7	10.1	.1	20.0	--	70.9
Graphite [1]	NA	13.4	1.3	14.7	35.8	5.2	--	44.3	--	85.3
Gypsum	26.9	2.9	2.9	32.7	47.3	2.2	11.4	4.9	1.5	67.3
Lime	18.6	.2	5.6	24.4	61.5	2.7	1.3	9.1	1.0	75.6
Magnesite [1]	NA	.2	2.2	2.4	60.3	.9	4.5	31.7	.2	97.6
Mica [2]	54.5	.6	2.5	57.6	23.9	1.8	--	16.7	--	42.4
Nitrogenous fertilizers, N content	23.7	1.7	1.0	26.4	52.0	1.2	2.0	18.0	.4	73.6
Phosphate rock	41.5	.2	.5	42.2	22.6	24.3	2.7	5.9	2.3	57.8
Potash, marketable, K_2O equivalent	29.6	--	.1	29.7	65.3	1.0	2.8	1.2	NA	70.3
Pumice [3]	24.0	2.0	1.7	27.7	71.9	.1	NA	NA	.3	72.3
Salt	27.5	3.9	3.0	34.4	37.9	1.3	1.1	22.5	2.8	65.6
Sodium compounds: [2]										
Sodium carbonate	28.0	1.6	.8	30.4	60.6	.5	.2	7.7	.6	69.6
Sodium sulfate	35.7	5.2	1.7	42.6	47.7	--	2.6	7.1	--	57.4

Strontium minerals [3]	19.5	53.7	3.4	76.6	22.1	--	.3	1.0	--	23.4
Sulfur, elemental basis:										
Elemental	38.0	12.3	.5	50.8	44.4	--	3.9	.9	--	49.2
From pyrite	3.1	.2	--	3.3	73.7	4.0	--	18.0	1.0	96.7
Byproduct	48.5	1.3	.8	50.6	33.1	1.2	2.8	11.6	.7	49.4
Talc, soapstone, pyrophyllite	19.1	(4)	5.5	24.6	25.8	.4	--	47.5	1.7	75.4
Vermiculite [2 3]	52.6	NA	1.0	53.6	NA	43.1	--	3.3	--	46.4
MINERAL FUELS AND RELATED MATERIALS										
Carbon black [2 3]	42.5	1.2	5.4	49.1	32.7	1.2	.4	14.4	2.2	50.9
Coal:										
Anthracite and bituminous	24.9	.2	.4	25.5	41.0	3.2	.3	26.9	3.1	74.5
Lignite	3.1	--	--	3.1	91.9	--	.7	.8	3.5	96.9
Coke: [2 3]										
Metallurgical	15.8	.6	1.2	17.6	55.8	1.5	.6	23.1	1.4	82.4
Other	--	NA	.1	.1	55.4	.8	.8	42.4	.5	99.9
Gas, natural, marketed	46.6	1.4	2.3	50.3	39.5	1.7	2.9	5.1	.5	49.7
Natural gas liquids	64.9	3.2	4.0	72.1	11.6	3.9	9.8	.5	2.1	27.9
Peat	.6	--	(4)	.6	99.4	--	(4)	(4)	(4)	99.4
Petroleum:										
Crude	16.3	1.9	5.8	24.0	20.2	10.1	38.3	6.7	.7	76.0
Refinery products	28.6	3.5	5.0	37.1	40.8	1.7	4.9	14.4	1.1	62.9

NA Not available; no adequate basis for estimation available.

[1] Percentages based on a world total that excludes data for the United States (withheld to avoid disclosing company proprietary data), inclusion of which would significantly alter percentages for all continental groups.

[2] Percentages based on a world total that excludes data for the People's Republic of China (no adequate basis for estimation available), inclusion of which might significantly alter percentages for all continental groups.

[3] Percentages based on a world total that excludes data for the U.S.S.R. (no adequate basis for estimation available), inclusion of which might significantly alter percentages for all continental groups.

[4] Less than ½ unit.

Table 4.—Role of various country groups in production of major mineral commodities in 1976

(Percent)

Commodity	Developed market economy countries	Developing market economy countries	Total market economy countries	Centrally planned economy countries	EEC	EFTA	OECD [1]	OPEC [2]	CMEA [3]
METALS									
Aluminum:									
Bauxite, gross weight	41.2	44.5	85.7	14.3	2.9	--	39.3	1.2	13.1
Alumina, gross weight	73.5	10.5	84.0	16.0	12.0	--	66.3	--	14.1
Unalloyed ingot metal	73.5	8.2	81.7	18.3	15.0	7.3	68.6	.6	16.7
Antimony, mine output, metal content	27.1	43.6	70.7	29.3	1.4	.8	15.0	.1	12.1
Arsenic, white [4 5]	42.6	36.2	78.8	21.2	20.8	21.6	42.6	--	21.2
Beryl concentrate, gross weight [4]	.1	31.8	31.9	68.1	--	--	NA	--	68.1
Bismuth [4]	41.6	48.3	89.9	10.1	1.9	.4	39.6	--	3.6
Cadmium, smelter	70.2	7.9	78.1	21.9	24.6	3.3	69.1	--	20.5
Chromite, gross weight	33.4	32.3	65.7	34.3	--	4.8	13.7	1.9	24.6
Cobalt:									
Mine output, metal content	21.3	66.7	88.0	12.0	--	4.5	21.3	NA	12.0
Refined	23.1	67.1	90.2	9.8	9.9	7.9	23.1	--	9.8
Columbium-tantalum concentrates, gross weight [6]	14.2	85.8	100.0	NA	--	--	14.2	2.8	NA
Copper:									
Mine output, metal content	39.7	42.0	81.7	18.3	.1	1.7	35.8	1.0	16.6
Smelter	48.8	32.8	81.6	18.4	2.9	1.6	44.9	.1	16.8
Gold, mine output, metal content	67.8	11.9	79.7	20.3	.1	.3	9.5	.2	19.7
Iron and steel:									
Iron ore, gross weight	39.5	24.5	64.0	36.0	6.0	4.2	37.7	2.6	27.6
Metal:									
Pig iron and ferroalloys	60.0	6.1	66.1	33.9	18.6	1.8	58.8	.4	27.3
Crude steel	59.1	7.4	66.5	33.5	19.9	2.0	59.9	.3	29.4
Lead:									
Mine output, metal content	50.8	20.8	71.6	28.4	3.9	2.6	47.2	1.1	21.8
Smelter	59.1	15.9	75.0	25.0	12.9	3.6	57.6	(7)	22.6
Magnesium, primary smelter [4]	73.8	(7)	73.8	26.2	6.2	15.9	73.8	--	25.8
Manganese ore, gross weight	31.7	28.2	59.9	40.1	(7)	--	9.5	9.2	36.0
Mercury, mine output, metal content	42.3	21.1	63.4	36.6	10.6	.2	39.0	12.9	25.7
Molybdenum, mine output, metal content	74.7	12.9	87.6	12.4	--	--	74.7	NA	10.7
Nickel:									
Mine output, metal content	48.2	26.3	74.5	25.5	--	.9	45.5	2.4	24.6
Smelter	57.8	15.9	73.7	26.3	5.8	5.2	55.6	--	26.3
Platinum-group metals, mine output	52.8	.4	53.2	46.8	--	(7)	7.6	--	46.8
Selenium, smelter [6]	92.8	7.2	100.0	NA	5.3	7.1	88.8	--	NA
Silver, mine output, metal content	42.5	35.8	78.3	21.7	2.0	1.7	40.1	.4	20.9
Tellurium, smelter [4]	85.1	14.9	100.0	NA	NA	--	85.1	--	NA
Tin:									
Mine output, metal content [4]	8.2	68.7	76.9	23.1	1.8	.2	7.0	11.9	14.2
Smelter	14.9	62.3	77.2	22.8	6.7	.2	14.6	11.3	14.0

Titanium concentrates, gross weight:									
Ilmenite	77.4	10.7	88.1	11.9	--	27.8	77.4	--	11.9
Rutile [4]	92.5	1.2	93.7	6.3	--	--	92.5	--	6.3
Tungsten, mine output, metal content	25.8	28.0	53.8	46.2	1.9	4.9	28.0	(7)	19.4
Uranium oxide, mine output, U_3O_8 content [5 6]	86.2	13.8	100.0	NA	7.6	.6	74.7	6.1	NA
Vanadium, mine output, metal content	63.3	6.1	69.4	30.6	--	6.9	29.7	--	30.6
Zinc:									
Mine output, metal content	54.5	22.7	77.2	22.8	5.2	3.9	51.2	1.4	18.3
Smelter	65.6	8.7	74.3	25.7	19.8	3.6	62.0	.3	21.1
NONMETALS									
Asbestos	44.1	7.3	51.4	48.6	3.2	--	36.8	--	45.2
Barite	47.2	32.9	80.1	19.9	18.8	--	49.8	4.5	12.4
Cement, hydraulic	48.2	20.8	69.0	31.0	17.8	2.9	47.6	2.8	25.7
Clays: [5]									
Bentonite [6]	85.6	9.7	95.3	4.7	5.1	NA	84.9	1.8	4.7
Fuller's earth [6]	93.2	6.8	100.0	NA	12.5	--	98.2	1.5	NA
Kaolin	70.2	10.8	81.0	19.0	31.8	.7	70.1	1.1	19.0
Diamond:									
Gem	35.4	43.4	78.8	21.2	--	--	--	2.0	21.2
Industrial	12.9	59.5	72.4	27.6	--	--	--	2.3	27.6
Diatomite	66.4	7.2	73.6	26.4	30.9	1.4	66.4	.9	26.4
Feldspar	70.9	15.3	86.2	13.8	31.7	6.2	68.2	.2	13.8
Fluorspar	37.0	32.4	69.4	30.6	18.9	.1	30.6	--	22.1
Graphite [4]	13.4	36.3	49.7	50.3	4.0	9.3	13.3	--	22.5
Gypsum	64.9	21.3	86.2	13.8	25.6	1.6	63.2	11.5	12.2
Lime	51.2	8.9	60.1	39.9	17.3	2.1	47.9	1.2	39.9
Magnesite [4]	33.5	10.8	44.3	55.7	--	10.4	32.9	(7)	27.7
Mica [5]	59.2	20.5	79.7	20.3	1.9	1.5	58.1	--	20.3
Nitrogenous fertilizers, N content	49.7	12.1	61.8	38.2	15.1	2.9	48.7	2.1	30.7
Phosphate rock	44.0	28.2	72.2	27.8	.1	(7)	41.8	.9	22.5
Potash, marketable, K_2O equivalent	50.4	1.1	51.5	48.5	15.8	--	47.6	--	47.3
Pumice [6]	96.2	3.8	100.0	NA	62.1	.1	96.2	NA	NA
Salt	54.2	12.7	66.9	33.1	20.1	.9	54.2	.8	14.8
Sodium compounds: [5]									
Sodium carbonate	59.3	6.4	65.7	34.3	22.1	1.5	58.9	--	34.2
Sodium sulfate	74.9	9.5	84.4	15.6	19.2	5.9	76.9	.6	15.6
Strontium minerals [6]	41.6	58.4	100.0	NA	9.9	--	41.6	.3	NA
Sulfur, elemental basis:									
Elemental	38.2	16.7	54.9	45.1	.2	--	38.3	3.8	44.2
From pyrite	37.5	6.5	44.0	56.0	6.3	8.9	36.1	--	47.1
Byproduct	79.0	6.4	85.4	14.6	16.0	2.7	77.9	2.8	13.1
Talc, soapstone, pyrophyllite	62.3	20.1	82.4	17.6	8.4	6.9	62.0	--	9.5
Vermiculite [5 6]	97.5	2.5	100.0	NA	--	--	55.1	--	NA
MINERAL FUELS AND RELATED MATERIALS									
Carbon black [5 6]	85.5	10.9	96.4	3.6	26.3	.9	85.0	1.0	3.6
Coal:									
Anthracite and bituminous	42.0	6.0	48.0	52.0	9.8	(7)	39.1	.1	30.8
Lignite	29.9	1.2	31.1	68.9	15.8	.4	26.5	--	68.8

See footnotes at end of table.

Table 4.—Role of various country groups in production of major mineral commodities in 1976—Continued

(Percent)

Commodity	Developed market economy countries	Developing market economy countries	Total market economy countries	Centrally planned economy countries	EEC	EFTA	OECD [1]	OPEC [2]	CMEA [3]
MINERAL FUELS AND RELATED MATERIALS—Continued									
Coke: [5 6]									
Metallurgical	54.3	5.2	59.5	40.5	21.0	0.8	53.5	0.1	32.2
Other	31.5	21.7	53.2	46.8	8.5	.8	30.9	NA	46.8
Gas, natural, marketed	59.9	9.0	68.9	31.1	12.5	.1	59.9	5.6	26.8
Natural gas liquids	68.5	21.4	89.9	10.1	3.5	--	68.5	16.1	10.1
Peat	5.2	(7)	5.2	94.8	4.3	.3	5.2	--	94.8
Petroleum:									
Crude	18.5	59.7	78.2	21.8	.7	.6	18.6	53.2	18.7
Refinery products	61.8	18.3	80.1	19.9	19.0	1.9	61.2	6.2	17.2

NA Not available; no adequate basis for estimation available.

[1] Organization for Economic Cooperation and Development (OECD) comprises Australia, Austria, Belgium, Canada, Denmark, Finland, France, West Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

[2] Organization of Petroleum Exporting Countries (OPEC) comprises Algeria, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela.

[3] Council for Mutual Economic Assistance (CMEA) comprises Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.

[4] Percentages based on a world total that excludes data for the United States (withheld to avoid disclosing company proprietary data), inclusion of which would significantly alter percentages for all country groups.

[5] Percentages based on a world total that excludes data for the People's Republic of China (no adequate basis for estimation available), inclusion of which might significantly alter percentages for all country groups.

[6] Percentages based on a world total that excludes data for the U.S.S.R. (no adequate basis for estimation available), inclusion of which might significantly alter percentages for all country groups.

[7] Less than ½ unit.

Table 5.—Value of world export trade in major mineral commodity groups [1]

(Million dollars)

Commodity group	r 1971	r 1972	r 1973	r 1974	1975
Metals:					
All ores, concentrates, scrap	7,231	7,762	11,017	15,683	14,685
Iron and steel	17,705	20,102	28,455	46,435	45,831
Nonferrous metals	10,489	11,862	17,284	25,221	18,243
Subtotal	35,425	39,726	56,756	87,339	78,759
Nonmetals, crude	2,743	3,197	3,840	5,856	6,257
Mineral fuels	36,153	42,104	63,565	168,104	168,560
Total	74,321	85,027	124,161	261,299	253,576
All commodities	346,271	413,837	574,093	833,290	872,528

r Revised.

[1] Data presented are for selected major mineral commodity groups of the Standard International Trade Classification—Revised (SITC–R) and as such exclude some mineral commodities classified in that data array together with other (nonmineral) commodities. SITC–R categories included are as follows: All ores, concentrates, scrap—SITC Division 28; iron and steel—SITC Division 67; nonferrous metals—SITC Division 68; nonmetals (crude only)—SITC Division 27; and mineral fuels—SITC Division 3. Major items not included are the metals, metalloids, and metal oxides of SITC Group 513; mineral tar and other coal-, petroleum-, or gas-derived crude chemicals of SITC Division 52; manufactured fertilizers of SITC Division 56; and nonmetallic mineral manufactures of SITC Groups 661, 662, 663, and 667.

Data include special category exports, ships' stores and bunkers, and other exports of minor importance, and exclude the intertrade of the centrally planned economy countries of Asia and trade between West Germany and East Germany.

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 31, No. 5, May 1977, pp. xxvii–lii.

Table 6.—Distribution of value of world export trade in major mineral commodity groups [1]

(Percent)

Commodity group	1971	1972 r	1973	1974	1975
Metals:					
All ores, concentrates, scrap	r 9.7	9.1	8.9	r 6.0	5.8
Iron and steel	r 23.8	23.6	r 22.9	r 17.8	18.1
Nonferrous metals	r 14.1	14.0	r 13.9	r 9.7	7.2
Total	r 47.6	46.7	r 45.7	r 33.5	31.1
Nonmetals, crude	r 3.7	3.8	r 3.1	2.2	2.4
Mineral fuels	48.7	49.5	r 51.2	r 64.3	66.5

r Revised.

[1] For detailed definition of groups, see footnote 1, table 5.

Table 7.—Growth of value of world export trade in major mineral commodity groups [1]

(Percent change from previous year)

Commodity group	1971 r	1972 r	1973 r	1974	1975
Metals:					
All ores, concentrates, scrap	−10.8	+7.3	+41.9	r +42.4	−6.4
Iron and steel	+3.7	+13.5	+41.6	r +63.2	−1.3
Nonferrous metals	−14.0	+13.1	+45.7	r +45.9	−27.7
All metals	−5.2	+12.1	+42.9	r +53.9	−9.8
Nonmetals, crude	+15.3	+16.6	+20.1	r +52.5	+6.9
Mineral fuels	+27.1	+16.5	+51.0	r +164.5	+.3
All major mineral commodity groups	+9.0	+14.4	+46.0	r +110.5	−3.0
All commodities	+10.9	+19.5	+38.7	+45.1	+4.7

r Revised.

[1] For detailed definition of groups, see footnote 1, table 5.

Table 8.—Significance of export trade in major mineral commodities [1] to total trade of various world areas [2] in 1975

Area and country	Value, millions				Major mineral commodities as percentage of all commodities	
	Major mineral commodities		All commodities			
	Exports from	Exports to	Exports from	Exports to	Exports from	Exports to
Northern North America:						
Canada	$10,493	$5,594	$32,300	$31,474	32.5	17.8
United States	10,482	36,227	106,157	94,068	9.9	38.5
Total [3]	20,975	41,821	138,457	125,542	15.1	33.3
Latin America	[4] 23,295	17,189	48,533	56,849	[5] 48.0	30.2
Europe:						
Market economy countries:						
EEC	45,469	84,302	295,768	285,718	15.4	29.5
EFTA	7,090	13,767	52,928	60,071	13.4	22.9
Other [3]	2,238	9,685	14,150	29,458	15.8	32.9
Subtotal	54,797	107,754	362,846	375,247	15.1	28.7
Centrally planned economy countries	22,759	19,152	77,358	82,456	29.4	23.2
Total [3]	77,556	126,906	440,204	457,703	17.6	27.7
Africa:						
South Africa, Republic of	([6])	1,658	5,315	8,386	([6])	19.8
Other	[7] 24,407	6,251	34,096	40,766	[5] 71.6	15.3
Total [3]	24,407	7,909	39,411	49,152	61.9	16.1
Near East	[8] 75,818	7,696	80,403	43,125	[5] 94.3	17.8

Far East and South Asia:						
Market economy countries:						
Japan	[9] 10,925	28,753	55,754	50,505	[5] 19.6	56.9
Other	[4] 11,595	14,317	45,795	55,970	[5] 25.3	25.6
Subtotal [8]	22,520	43,070	101,549	106,475	22.2	40.5
Centrally planned economy countries	1,445	2,030	7,187	8,370	20.1	24.3
Total [3]	23,965	45,100	108,736	114,845	22.0	39.3
Australia and New Zealand	[4] 4,236	2,070	13,663	12,123	[5] 31.0	17.1
Not reported [3]	3,324	4,885	3,121	13,189	([10])	37.0
Grand total	253,576	253,576	872,528	872,528	29.1	29.1

[1] For detailed definition of groups, see footnote 1, table 5.

[2] Regional groupings generally conform to United Nations practice; modifications and special aspects of classification scheme are as follows: (1) Latin America includes Mexico, Central America, and South America but excludes Caribbean Islands; (2) other market economy Europe includes Greece and Spain, as well as Yugoslavia (sometimes considered a centrally planned economy country); (3) centrally planned economy Europe includes Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and the U.S.S.R.; (4) other Africa corresponds to the United Nations category "Developing Africa"; (5) Near East corresponds to the United Nations category "Developing Asia, Middle East"; (6) other market economy Far East and South Asia corresponds to the United Nations category "Developing Asia, other"; (7) centrally planned economy Far East and South Asia includes the People's Republic of China, North Korea, Mongolia, and Vietnam; and (8) the category "Not reported" is derived by subtracting all listed figures from reported totals and includes the Caribbean and Pacific Islands.

[3] Not reported in source, but derived from data therein.

[4] Partial figure; value of crude nonmetals is excluded but is presumably included under "Not reported."

[5] Percentage based on partial figure; see footnote to entry in "Exports from" value column.

[6] Not reported separately for this area; presumably included under "Not reported." Percentage can not be calculated.

[7] Partial figure; value of iron and steel is excluded but is presumably included under "Not reported."

[8] Partial figure; value of mineral fuels only. Totals for other commodity groups are presumably included under "Not reported."

[9] Partial figure; values of metal ores, concentrates, and scrap and crude nonmetals are excluded but are presumably included under "Not reported."

[10] Value of major mineral commodities from "Not reported" exceeds value of all commodities exported from that area by $203 million. Discrepancy is presumably owing to (1) revisions in totals reported in later source data for developed market economy countries which could not be distributed among those countries individually, and (2) rounding.

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 31, No. 2, February 1977, pp. xxvii–lv; and V. 31, No. 5, May 1977, pp. xviii–lii.

Table 9.—Direction of trade in major

(Million

Source	Northern North America			Latin America	Market economy Europe				Centrally planned economy Europe
	Canada	United States	Total [3]		EEC	EFTA	Other [3]	Total	
Northern North America:									
Canada	XX	7,160	7,160	182	1,559	203	68	1,830	20
United States	2,020	XX	2,020	1,664	2,329	250	402	2,981	73
Total [3]	2,020	7,160	9,180	1,846	3,888	453	470	4,811	93
Latin America [5]	1,327	11,237	12,564	5,254	2,541	281	362	3,184	273
Europe:									
Market economy countries:									
EEC	262	2,000	2,262	1,345	24,270	5,285	1,603	31,158	3,528
EFTA	53	394	447	134	3,947	1,364	199	5,510	594
Other [3]	16	195	211	42	874	129	75	1,078	471
Subtotal	331	2,589	2,920	1,521	29,091	6,778	1,877	37,746	4,593
Centrally planned economy countries	29	218	247	697	4,700	2,720	1,515	8,935	11,093
Total [3]	360	2,807	3,167	2,218	33,791	9,498	3,392	46,681	15,686
Africa:									
South Africa, Republic of [7]	NA	NA	NA	NA	NA	NA	NA	NA	NA
Other [8]	188	5,117	5,305	1,525	13,858	622	956	15,436	371
Total [3]	188	5,117	5,305	1,525	13,858	622	956	15,436	371
Near East [9]	1,498	5,178	6,676	4,277	26,755	2,402	4,016	33,173	1,493
Far East and South Asia:									
Market economy countries:									
Japan [10]	154	1,953	2,107	1,215	663	209	268	1,140	695
Other [5]	8	2,272	2,280	654	772	70	42	884	176
Subtotal [3]	162	4,225	4,387	1,869	1,435	279	310	2,024	871
Centrally planned economy countries	1	45	46	8	136	18	14	168	227
Total [3]	163	4,270	4,433	1,877	1,571	297	324	2,192	1,098
Australia and New Zealand [5]	6	93	99	109	676	11	71	758	23
Not reported [3]	32	365	397	83	1,222	203	94	1,519	115
Grand total [4]	5,594	36,227	41,821	17,189	84,302	13,767	9,685	107,754	19,152

NA Not available. XX Not applicable.

[1] For detailed definition of major mineral commodity groups, see footnote 1, table 5.

[2] For detailed definition of areas listed, see footnote 2, table 8.

[3] Not reported in source, but derived from data therein.

[4] As reported in source; detail may not add to totals shown. Discrepancies are presumably owing to (1) revisions in totals reported in later source data for developed market economy countries which could not be distributed among those countries individually, and (2) rounding.

[5] Partial figure; value of crude nonmetals is excluded but is presumably included under "Not reported."

[6] Reported detail exceed reported totals by $1 million. Discrepancy is presumably owing to (1) revisions in totals reported in later source data for developed market economy countries which could not be distributed among those countries individually, and (2) rounding.

mineral commodities in 1975 [1 2]

dollars)

Destination										
Africa			Near East	Market economy Far East and South Asia			Centrally planned economy Far East and South Asia	Australia and New Zealand	Not reported [3]	Grand total [4]
Republic of South Africa	Other	Total [3]		Japan	Other	Total [3]				
22	25	47	36	975	131	1,106	39	44	29	10,493
67	298	365	511	2,104	577	2,681	73	72	42	10,482
89	323	412	547	3,079	708	3,787	112	116	71	20,975
16	583	599	275	676	78	754	10	2	380	23,295
303	2,203	2,506	1,612	121	440	561	504	107	1,886	45,469
34	74	108	74	46	42	88	67	24	44	7,090
3	175	178	171	14	13	27	33	--	27	2,238
340	2,452	2,792	1,857	181	495	676	604	[6] 130	1,957	54,797
--	295	295	241	526	306	832	262	3	154	22,759
340	2,747	3,087	2,098	707	801	1,508	866	133	2,111	77,556
XX	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	512	515	73	961	138	1,099	36	4	43	24,407
3	512	515	73	961	138	1,099	36	4	43	24,407
1,067	1,409	2,476	2,321	15,232	7,867	23,099	--	1,055	1,248	75,818
131	427	558	1,802	XX	2,263	2,263	875	239	31	10,925
2	101	103	309	4,813	1,932	6,745	18	218	208	11,595
133	528	661	2,111	4,813	4,195	9,008	893	457	239	22,520
--	20	20	17	841	119	960	--	1	--	1,445
133	548	681	2,128	5,654	4,314	9,968	893	458	239	23,965
9	10	19	42	1,947	252	2,199	89	186	712	4,236
1	119	120	212	497	159	656	24	117	81	3,324
1,658	6,251	7,909	7,696	28,753	14,317	43,070	2,030	2,070	4,885	253,576

[7] Not reported separately for this area; presumably included under "Not reported."
[8] Partial figure; value of iron and steel is excluded but is presumably included under "Not reported."
[9] Partial figure; value of mineral fuels only. Totals for other commodity groups are presumably included under "Not reported."
[10] Partial figure; values of metal ores, concentrates, and scrap and crude nonmetals are excluded but are presumably included under "Not reported."

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 31, No. 2, February 1977, pp. xxviii–liv.

Table 10.—Export sources and destinations for major mineral commodity group [1] shipments, by value, in 1975

(Million dollars)

Area and country [2]	Exports from					Exports to				
	Metal ores, concentrates, scrap	Iron and steel	Non-ferrous metals	Non-metals, crude	Mineral fuels	Metal ores, concentrates, scrap	Iron and steel	Non-ferrous metals	Non-metals, crude	Mineral fuels
Northern North America:										
Canada	2,202	748	1,719	490	5,334	248	1,029	294	195	3,828
United States	1,355	2,457	1,313	892	4,465	1,791	4,197	2,234	333	27,672
Total [3]	3,557	3,205	3,032	1,382	9,799	2,039	5,226	2,528	528	31,500
Latin America	2,755	306	1,282	(4)	18,952	373	3,441	803	281	12,291
Europe:										
Market economy countries:										
EEC	1,644	21,427	5,508	1,148	15,742	5,299	12,363	8,408	2,485	55,747
EFTA	809	3,105	1,559	168	1,449	735	3,168	1,446	476	7,942
Other [3]	133	850	561	161	533	586	1,783	488	318	6,510
Subtotal	2,586	25,382	7,628	1,477	17,724	6,620	17,314	10,342	3,279	70,199
Centrally planned economy countries	1,426	4,749	1,641	1,051	13,892	1,550	7,707	1,404	988	7,503
Total [3]	4,012	30,131	9,269	2,528	31,616	8,170	25,021	11,746	4,267	77,702
Africa:										
South Africa, Republic of	(4)	(4)	(4)	(4)	(4)	24	394	62	23	1,155
Other	885	(4)	1,422	1,334	20,766	44	2,453	308	99	3,347
Total [3]	885	(4)	1,422	1,334	20,766	68	2,847	370	122	4,502
Near East	(4)	(4)	(4)	(4)	75,818	43	4,089	388	186	2,990
Far East and South Asia:										
Market economy countries:										
Japan	(4)	10,165	540	(4)	220	3,105	143	1,010	403	24,092
Other	880	585	1,085	(4)	9,045	322	2,903	661	253	10,178
Subtotal [3]	880	10,750	1,625	(4)	9,265	3,427	3,046	1,671	656	34,270
Centrally planned economy countries	92	179	208	143	823	59	1,452	345	22	152
Total [3]	972	10,929	1,833	143	10,088	3,486	4,498	2,016	678	34,422
Australia and New Zealand	1,643	510	704	(4)	1,379	32	392	86	128	1,432
Not reported [3]	861	750	701	870	142	474	317	306	67	3,721
Grand total	14,685	45,831	18,243	6,257	168,560	14,685	45,831	18,243	6,257	168,560

[1] For detailed definition of major mineral commodity groups, see footnote 1, table 5.
[2] For detailed definition of areas listed, see footnote 2, table 8.
[3] Not reported in source, but derived from data therein.
[4] Not reported separately for this area; presumably included under "Not reported."

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 31, No. 2, February 1977, pp. xxviii–lv; and V. 31, No. 5, May 1977, pp. xviii–lii.

Table 11.—Iron ore consumption in selected major countries[1]

(Million metric tons)

Country	1974	1975	1976 p
EEC:			
Belgium	r 21.7	15.2	16.9
France[2]	r 50.8	39.8	42.1
Germany, West	r 55.7	42.7	43.6
Italy	r 15.2	15.2	16.4
Luxembourg	r 15.1	11.5	11.3
Netherlands	r 7.0	5.8	6.2
United Kingdom[3]	r 22.2	20.5	23.8
Total	r 187.7	150.7	160.3
EFTA:			
Austria	r 6.9	6.1	6.7
Finland	r 2.0	1.7	2.0
Norway	r 1.2	1.2	1.3
Portugal	.4	.5	.6
Sweden	r 11.9	11.3	11.5
Total	r 22.4	20.8	22.1
Other market economy countries of Europe:			
Spain	r 11.5	e 12.4	e 12.6
Yugoslavia	r 4.0	3.8	3.4
Total	r 15.5	16.2	16.0
Centrally planned economy countries of Europe:			
Czechoslovakia	r 15.0	16.0	14.5
Hungary	r 4.4	4.2	4.1
Poland[4]	r 11.2	e 11.5	11.9
Romania	10.0	e 10.5	e 11.0
U.S.S.R	177.2	182.8	e 186.0
Total	r 217.8	225.0	227.5
Other:			
Canada	14.6	13.8	15.7
Japan	r 122.5	119.0	117.0
Turkey	2.2	e 2.1	e 2.1
United States	r 131.1	107.9	116.0
Total	r 270.4	242.8	250.8
Grand total	r 713.8	655.5	676.7

e Estimate. p Preliminary. r Revised.

[1] Annual data based on a total of three categories: Iron ore for steelworks, iron ore for agglomerates, and iron ore and concentrate for blast furnaces.

[2] Includes sinter produced at mines.

[3] Calcined ores.

[4] Includes 208,000 tons of contained metal for steelworks in 1974, 216,000 tons (estimated) in 1975, and 224,000 tons in 1976.

Source: United Nations Economic Commission for Europe. 1976 Annual Bulletin of Steel Statistics for Europe, New York. V. 4, 1977, 97 pp.

Table 12.—Iron and steel scrap consumption in selected countries [1]

(Thousand metric tons)

Country	1974	1975	1976 [p]
EEC:			
Belgium [2]	4,925	3,711	3,658
Denmark [3]	523	575	775
France [3 4 5]	9,380	7,536	8,132
Germany, West [5]	25,578	20,407	21,104
Ireland	[r 6] 120	[6] 91	[e] 50
Italy [3]	14,710	[r] 13,629	[e] 14,000
Luxembourg	1,903	1,373	1,431
Netherlands	2,125	[r] 1,586	1,775
United Kingdom [2 5]	16,955	15,899	[7] 12,747
Total [8]	[r] 76,219	[r] 64,807	63,672
EFTA:			
Austria	[r 5] 1,965	[r] 1,706	1,807
Finland	709	696	[3] 575
Norway [2 4 5]	559	561	538
Portugal	362	[3 5] 156	258
Sweden [2 3]	3,737	3,429	[e] 3,300
Total [8]	[r] 7,332	[r] 6,548	6,478
Other market economy countries of Europe:			
Spain	7,465	[6] 6,540	[e] 6,500
Yugoslavia [3 4 5 9]	1,629	1,708	1,585
Total [8]	[r] 9,094	[r] 8,248	8,085
Centrally planned economy countries of Europe:			
Czechoslovakia [2 4 5]	6,918	7,154	7,337
Germany, East [2 3 4 5]	4,387	4,402	4,642
Hungary [2 4 5]	2,076	2,170	2,195
Poland	8,237	[e] 8,500	9,391
Romania [e 2 4 5 10]	3,000	3,200	3,270
U.S.S.R. [2 3 4 5 11]	46,862	46,998	[e] 47,100
Total [8]	71,480	72,424	73,935
Latin America: [5 12]			
Argentina	1,772	1,595	[e] 1,750
Brazil	[r] 3,610	3,665	[e] 3,700
Chile	227	168	[e] 175
Colombia	168	225	[e] 160
Mexico	[r] 3,125	3,323	[e] 3,330
Peru	158	174	[e] 100
Venezuela	568	527	[e] 500
Other [13]	[r] 29	40	[e] 35
Total [8]	[r] 9,657	9,717	[e] 9,750
Other:			
Canada [2 3 4 5]	7,114	6,753	6,469
India [2 3 4 5]	[14] 1,524	[e] 1,800	[e] 1,750
Japan [5]	46,146	34,214	38,224
South Africa, Republic of [e 2 3 4 5]	2,440	2,700	2,940
Turkey [2 5]	637	[r e] 600	[e] 730
United States [2]	[r] 95,693	74,689	89,910
Total [8]	[r] 153,554	[r] 120,756	140,023
Grand total [8]	[r] 327,336	[r] 282,500	301,943

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Unless otherwise noted, figures represent consumption of scrap in the production of pig iron, ferroalloys, crude steel, foundry products, and rerolled steel, as well as in other unspecified uses by the steel industry and by other unspecified industries. Also, unless otherwise noted, figures are from: United Nations Economic Commission for Europe. 1976 Annual Bulletin of Steel Statistics for Europe, New York. V. 4, 1977, 97 pp.

[2] Excludes scrap consumed in rerolling.

[3] Excludes scrap consumed in foundries.

[4] Excludes scrap consumed within the steel industry for purposes other than rerolling and production of pig iron, ferroalloys, crude steel, and foundry products.

[5] Excludes scrap used outside the steel industry.

[6] Organization for Economic Cooperation and Development. The Iron and Steel Industry in 1975, Paris. 1976, 61 pp.

[7] British Steel Corporation. International Steel Statistics, the United Kingdom. 1976, 43 pp.

[8] Total of listed figures only.

[9] Following United Nations practice, Yugoslavia has been included with market economy countries of Europe.

[10] Excludes scrap used in production of pig iron.

[11] Excludes scrap used in production of steel by any method other than open-hearth furnace.

[12] Data for 1974–75 are from: Latin American Iron and Steel Institute. Statistical Yearbook of Steelmaking and Iron Ore Mining in Latin America 1975, Santiago, Chile. 1976, 193 pp. Data for 1976 are U.S. Bureau of Mines estimates.

[13] Includes, Uruguay plus unspecified countries in Central America, as reported in source.

[14] British Steel Corporation. International Steel Statistics, India. 1974, 57 pp.

Table 13.—Estimated world consumption of major nonferrous metals [1]

(Thousand metric tons)

Commodity	1974 r	1975	1976 p
Aluminum [2]	14,201	12,139	14,483
Copper [3]	8,396	7,469	8,558
Lead [4]	4,132	3,646	3,968
Tin [5]	181	156	177
Zinc [6]	5,753	4,880	5,602

p Preliminary. r Revised.

[1] In general, figures are totals for major consuming countries only; sum of consumption by excluded minor consumers may be significant. Data for centrally planned economy countries included are listed as conjectural in sources.

[2] Includes secondary metal.

[3] Primary and secondary refined metal.

[4] Chiefly primary but includes some secondary.

[5] Primary only, as reported by the International Tin Council. Centrally planned economy countries are all excluded; consumption of primary and secondary tin by these countries is estimated at about 60,000 tons annually.

[6] Primary and secondary slab.

Source: American Bureau of Metal Statistics, Inc. Nonferrous Metal Data, 1975, New York. 1976, 143 pp.

Table 14.—World energy consumption, by energy source [1]

(Million metric tons, unless otherwise specified, of standard coal equivalent [2])

Area [3] and year	Solid fuels	Liquid fuels	Natural and imported gas	Hydro, nuclear, imported electricity	Aggregate	
					Total	Per capita (kilograms)
Market economy:						
North America:						
1971	479	1,084	869	58	2,469	10,880
1972	517	1,170	886	64	2,637	11,424
1973	513	1,226	875	70	2,683	11,534
1974	517	1,183	841	79	2,621	11,176
1975	551	1,155	787	85	2,578	10,900
1976	570	1,244	814	87	2,716	11,395
Caribbean America:						
1971	7	102	32	4	145	1,148
1972	7	108	34	4	153	1,183
1973	8	117	38	4	168	1,259
1974	9	122	39	5	175	1,277
1975	10	122	39	5	175	1,234
1976	10	130	39	5	185	1,265
Other America:						
1971	8	94	10	7	119	742
1972	7	100	11	8	126	767
1973	8	108	12	9	137	815
1974	8	112	13	11	145	840
1975	9	114	14	12	149	837
1976	10	120	15	13	158	868
Western Europe:						
1971	416	804	131	48	1,399	3,925
1972	379	855	168	52	1,455	4,051
1973	392	909	193	54	1,547	4,281
1974	388	853	220	58	1,520	4,181
1975	368	807	234	62	1,471	4,025
1976	394	868	251	60	1,573	4,289
Africa:						
1971	63	52	2	3	121	334
1972	63	55	5	4	128	344
1973	67	59	4	4	134	353
1974	69	63	5	4	142	364
1975	74	67	5	5	151	376
1976	77	73	10	5	164	397
Near East:						
1971	7	54	27	1	88	821
1972	7	59	29	1	97	875
1973	8	67	35	1	111	977
1974	8	73	40	1	122	1,049
1975	8	83	40	1	132	1,101
1976	9	92	42	2	144	1,169

See footnotes at end of table.

Table 14.—World energy consumption, by energy source [1]—Continued

(Million metric tons, unless otherwise specified, of standard coal equivalent [2])

Area [3] and year	Solid fuels	Liquid fuels	Natural and imported gas	Hydro, nuclear, imported electricity	Aggregate	
					Total	Per capita (kilograms)
Market economy—Continued						
Far East:						
1971	172	373	14	17	576	508
1972	171	398	16	18	603	521
1973	181	450	20	16	667	564
1974	191	435	24	20	670	554
1975	197	426	28	21	672	544
1976	200	449	32	23	704	557
Oceania:						
1971	35	41	3	3	82	4,144
1972	36	42	4	3	86	4,272
1973	37	46	6	3	92	4,524
1974	40	48	6	4	98	4,739
1975	40	47	7	4	99	4,684
1976	44	49	9	4	106	4,953
Total market economy:						
1971	1,186	2,602	1,089	142	5,019	2,012
1972	1,189	2,787	1,154	153	5,284	2,080
1973	1,213	2,982	1,183	161	5,540	2,134
1974	1,232	2,891	1,189	181	5,494	2,076
1975	1,256	2,820	1,152	195	5,425	2,013
1976	1,313	3,025	1,212	199	5,748	2,093
Centrally planned economy:						
Europe: [4]						
1971	781	437	308	18	1,543	4,398
1972	793	462	324	18	1,597	4,513
1973	797	513	345	18	1,674	4,690
1974	801	545	368	20	1,734	4,817
1975	829	583	403	20	1,834	5,051
1976	852	604	445	22	1,922	5,251
Asia: [5]						
1971	421	60	3	5	489	590
1972	434	67	3	6	510	605
1973	468	76	4	6	554	648
1974	491	87	4	6	588	677
1975	514	93	5	7	618	698
1976	531	104	5	7	647	719
Total centrally planned economy:						
1971	1,202	496	311	23	2,032	1,724
1972	1,227	529	327	24	2,107	1,761
1973	1,265	590	349	24	2,227	1,838
1974	1,292	632	372	26	2,322	1,889
1975	1,343	675	407	26	2,452	1,965
1976	1,383	708	450	29	2,570	2,030
World total:						
1971	2,387	3,099	1,400	165	7,051	1,920
1972	2,417	3,316	1,481	177	7,391	1,977
1973	2,478	3,572	1,532	185	7,767	2,041
1974	2,524	3,524	1,561	207	7,816	2,017
1975	2,600	3,496	1,560	221	7,877	1,996
1976	2,696	3,733	1,662	228	8,318	2,069

[1] In most cases, data are aggregates of country figures representing apparent inland consumption—the arithmetic result of adding production and imports and subtracting from this sum the total of exports, bunker loadings, and additions to stocks (where the latter are known). All totals in this table are reported in source except those for "Total market economy," which are the sums of reported figures for developed and developing market economy areas. In some cases, data may not add to totals shown because of rounding and/or omission from detail of minor quantities not listed separately. A large share of the entries in this table have been revised from those appearing in previous editions of this chapter owing to revisions in the new edition of the source; such revisions have not been identified by footnote.

[2] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.

[3] Areas listed are those appearing in source and have not been conformed in scope to standard terms used in the Minerals Yearbook.

[4] Includes Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and the U.S.S.R.

[5] Includes the People's Republic of China, North Korea, Mongolia, and Vietnam.

Source: United Nations. World Energy Supplies 1972–76, New York. Statistical Papers, ser. J, No. 21, 1978, pp. 2–5.

Table 15.—Annual investment expenditures in the steel industry for selected countries

(Million dollars)

Country or country group	1974	1975
EEC	2,799	3,302
EFTA	517	475
Australia	92	131
Canada	373	238
Japan	2,795	2,033
Spain	NA	239
Turkey	206	180
United States	2,104	1,400
Total	8,886	7,998

NA Not available.

Source: Organization for Economic Cooperation and Development. The Iron and Steel Industry in 1976, Paris. 1977, p. 26.

Table 16.—Market economy country petroleum industry capital and exploration expenditures, by geographical area

(Million dollars)

Area and type of expenditure	1974	1975	1976
United States:			
Capital	16,625	17,725	22,085
Exploration	1,130	1,195	1,375
Total	17,755	18,920	23,460
Other Western Hemisphere:			
Capital	4,945	5,775	6,615
Exploration	405	380	385
Total	5,350	6,155	7,000
Western Europe:			
Capital	6,920	9,050	8,950
Exploration	225	300	325
Total	7,145	9,350	9,275
Africa:			
Capital	1,215	1,675	2,425
Exploration	150	200	175
Total	1,365	1,875	2,600
Near East:			
Capital	1,770	2,025	4,675
Exploration	50	50	75
Total	1,820	2,075	4,750
Far East:			
Capital	3,525	4,360	3,575
Exploration	225	200	200
Total	3,750	4,560	3,775
Unspecified: Capital [1]	8,700	9,015	8,400
World:			
Capital	43,700	49,625	56,725
Exploration	2,185	2,325	2,535
Grand total	45,885	51,950	59,260

[1] No exploration expenditures.

Source: Chase Manhattan Bank, Energy Economics Division. Capital Investments of the World Petroleum Industry, 1976, New York. December 1977, pp. 14-19.

Table 17.—Market economy country petroleum industry capital expenditures, by industry sector

(Million dollars)

Sector	1974	1975	1976
Production:			
Crude oil and natural gas	18,765	18,295	23,860
Natural gasoline plants	770	960	1,915
Pipelines	2,460	5,995	7,575
Marine	8,900	9,240	8,675
Refineries	7,720	8,725	6,910
Marketing	2,215	2,160	2,180
Chemical plants	1,995	3,145	4,500
Other	875	1,105	1,110
Total	43,700	49,625	56,725

Source: Chase Manhattan Bank, Energy Economics Division. Capital Investments of the World Petroleum Industry, 1976, New York. December 1977, pp. 14–19.

Table 18.—U.S. direct foreign investment in the mineral industry: Value, earnings, and income

(Million dollars)

Area and country	Mining, smelting, refining			Petroleum		
	Value	Earnings [1]	Income [2]	Value	Earnings [1]	Income [2]
1973	6,038	617	497	27,313	6,128	4,249
1974	5,790	868	680	30,195	13,433	11,714
1975:						
Canada [r]	3,053	248	99	6,220	852	303
Other Western Hemisphere:						
Latin America:						
Chile	[r] 12	NA	[3]	NA	NA	[3]
Peru	700	NA	[r] —17	[r] 246	NA	—98
Venezuela	NA	[r] 3	1	[r] 687	[r] 162	174
Other	[r] 303	[r] 38	25	[r] 1,133	[r] 64	[r] 77
Subtotal [r 4]	1,015	41	9	2,066	226	153
Other [r]	461	84	84	1,258	201	101
Total [r 5]	1,476	125	94	3,324	427	254
Western Europe:						
EEC:						
Denmark and Ireland	2	[3]	[3]	[r] 441	[r] —28	—21
United Kingdom	[r] 10	[3]	[3]	[r] 3,822	[r] 17	[r] —57
Other [r 6]	2	—3	[3]	5,269	419	416
Subtotal [4]	14	—3	[r] [3]	[r] 9,532	[r] 408	338
Other	27	[3]	[3]	[r] 1,862	[r] 115	[r] 43
Total	41	—3	[r] [3]	[r] 11,393	[r] 523	[r] 381
Africa: [r]						
South Africa, Republic of	NA	14	6	407	NA	NA
Other	488	NA	NA	1,336	419	282
Total [4]	[r] 488	14	6	1,743	419	282
Near East	5	2	[3]	[r] —4,888	[r] 1,441	[r] 1,416
Far East, South Asia, Pacific:						
Japan	--	--	--	[r] 1,313	45	12
Australia	[r] 1,055	[r] 231	189	[r] 882	NA	NA
New Zealand	NA	1	1	[r] 141	[r] —2	[3]
Other	181	NA	NA	[r] 2,746	[r] 782	[r] —123
Total [4]	[r] 1,236	[r] 232	190	[r] 5,082	[r] 825	[r] —111
International shipping	--	--	--	[r] 3,323	[r] 82	[r] 82
Grand total [r 5 7]	6,548	686	448	26,200	4,795	2,738
1976:						
Canada	3,200	253	126	7,153	1,002	279
Other Western Hemisphere:						
Latin America:						
Chile	5	—2	[3]	NA	NA	4
Peru	NA	NA	NA	NA	1	2
Venezuela	—21	NA	NA	230	47	46
Other	1,179	116	72	1,423	175	57
Subtotal [4]	1,163	114	72	1,653	223	109

See footnotes at end of table.

Table 18.—U.S. direct foreign investment in the mineral industry: Value, earnings, and income—Continued

(Million dollars)

Area and country	Mining, smelting, refining			Petroleum		
	Value	Earnings [1]	Income [2]	Value	Earnings [1]	Income [2]
1976—Continued						
Other Western Hemisphere—Continued						
Other	437	84	84	1,287	225	113
Total [5]	1,600	198	156	2,940	449	222
Western Europe:						
EEC:						
Denmark and Ireland	2	—1	(3)	513	NA	NA
United Kingdom	11	—1	(3)	5,117	—2	22
Other [6]	--	—1	(3)	5,541	402	355
Subtotal [4 5]	12	—3	(3)	11,171	400	377
Other	22	—2	(3)	2,274	132	122
Total	34	—5	(3)	13,445	532	499
Africa:						
South Africa, Republic of	NA	23	6	NA	42	NA
Other	534	NA	NA	1,599	463	384
Total [4]	534	23	6	1,599	505	384
Near East	8	2	(3)	—4,211	1,656	1,599
Far East, South Asia, Pacific:						
Japan	--	--	--	1,566	113	10
Australia	1,237	350	225	889	185	155
New Zealand	NA	(3)	(3)	NA	7	NA
Other	167	NA	NA	2,554	401	1,137
Total [4]	1,404	350	225	5,009	706	1,302
International shipping	--	--	--	3,169	222	35
Grand total [5 7]	7,058	929	591	29,713	5,072	4,334

r Revised. NA Not available.
[1] U.S. share in net earnings of subsidiary and branch profits.
[2] Sum of interest, dividends, and branch earnings.
[3] Less than ½ unit.
[4] Partial figures; exclude quantities for detail given in source as not reported.
[5] Detail may not add to totals shown because of independent rounding.
[6] Includes Belgium, France, West Germany, Italy, Luxembourg, and the Netherlands.
[7] Detail do not add to totals shown because of exclusion of some data in detail.

Source: U.S. Department of Commerce. Survey of Current Business. V. 57, No. 8, August 1977, pp. 32–55.

Table 19.—World merchant fleet distribution, by type of vessel [1]

	1972	1973	1974	1975	1976
Number of vessels:					
Tankers	4,581	4,813	5,121	5,311	5,383
Bulk carriers	3,539	3,800	4,075	4,272	4,570
Freighters	11,087	11,170	11,449	12,575	12,923
Other	1,802	1,817	1,804	[2] 714	[2] 710
Total	21,009	21,600	22,449	22,872	23,586
Gross tonnage:					
Tankers ----thousand metric tons	108,558	122,370	143,399	163,731	179,116
Bulk carriers ----do	64,822	74,660	82,313	88,194	95,451
Freighters ----do	65,179	66,790	68,855	75,284	77,939
Other ----do	11,984	11,907	11,799	[2] 5,833	[2] 5,697
Total ----do	250,543	275,727	306,366	333,042	358,203
Deadweight tonnage:					
Tankers ----do	192,894	220,481	261,440	302,217	335,600
Bulk carriers ----do	108,512	126,140	139,267	150,080	163,298
Freighters ----do	88,970	90,511	93,476	101,248	104,639
Other ----do	9,176	9,238	9,165	[2] 3,027	[2] 2,962
Total ----do	399,552	446,370	503,348	556,572	606,499

[1] Maritime Administration classification. "Tankers" includes whaling tankers. Vessels shown here as "Other" include combination passenger and cargo, combination passenger and refrigerated cargo, and refrigerated freighters, except as otherwise indicated. The contribution of these vessels to mineral commodity trade is regarded as minimal. Data are as of yearend.
[2] Excludes refrigerated freighters, which are included under "Freighters."

Source: U.S. Department of Commerce, Maritime Administration. Merchant Fleets of the World. September 1976.

Table 20.—World shipping loadings and unloadings [1]

(Million metric tons)

	1972	1973	1974 r	1975 r	1976
Loadings:					
Tanker cargo	1,654	1,873	1,837	1,644	1,797
Dry cargo	1,247	1,403	1,476	1,428	1,555
Total	2,901	3,276	3,313	3,072	3,352
Unloadings:					
Tanker cargo	1,643	1,862	1,784	1,660	1,614
Dry cargo	1,223	1,376	1,477	1,396	1,619
Total	2,866	3,238	3,261	3,056	3,233

r Revised.

[1] Data presented are as reported in source and as such may not be the arithmetic sum of figures presented in tables 21 and 22.

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 32, No. 1, January 1978, p. xxv.

Table 21.—World shipping of tanker cargo, by geographical area

(Million metric tons)

Area	Loadings					Unloadings				
	1972	1973	1974	1975	1976	1972	1973	1974	1975	1976
Market economy countries:										
Developed:										
Australia and New Zealand	2	3	3	r 3	3	16	16	17	15	15
Canada	5	7	7	6	4	24	25	22	r 21	18
Japan	2	1	2	r 1	2	245	273	r 267	247	259
South Africa, Republic of	--	--	--	--	--	14	15	14	r 16	16
United States	3	3	2	r 2	2	206	275	r 272	r 279	300
Western Europe	115	123	109	r 105	106	796	853	r 810	r 727	636
Other	22	27	r 26	r 26	26	20	25	r 27	r 28	28
Total	149	164	r 149	r 143	143	1,321	1,482	1,429	r 1,333	1,272
Developing:										
Caribbean	60	74	67	r 48	49	99	119	r 113	r 91	94
Far East	79	92	r 94	r 88	96	100	118	r 106	r 99	108
Near East	855	1,001	r 1,033	r 921	1,017	15	16	17	r 15	14
Northern Africa	165	166	127	r 124	141	8	9	9	r 9	9
Other Africa	103	18	130	r 106	117	15	17	r 17	r 16	15
Venezuela	163	164	146	r 110	130	--	--	--	--	--
Other Latin America	11	20	r 14	19	14	50	62	61	r 62	65
Other	1	101	--	--	--	4	3	r 4	r 4	2
Total	1,437	1,636	r 1,611	r 1,416	1,564	291	344	r 327	r 296	307
Centrally planned economy countries:										
U.S.S.R	63	69	70	r 73	78	8	13	4	6	7
Other	4	4	r 7	r 12	12	19	23	24	r 25	28
Total	67	73	r 77	r 85	90	27	36	28	r 31	35

r Revised.

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 32, No. 1, January 1978, pp. xxv–xxvii.

Table 22.—World shipping of dry cargo, by geographical area

(Million metric tons)

Area	Loadings					Unloadings				
	1972	1973	1974	1975	1976	1972	1973	1974	1975	1976
Market economy countries:										
Developed:										
Australia and New Zealand	121	149	166	r 170	166	16	21	24	r 24	22
Canada	94	105	99	96	111	38	41	39	r 43	38
Japan	52	55	65	r 69	74	277	315	r 330	302	317
South Africa, Republic of	18	19	19	r 21	21	7	7	11	r 11	11
United States	207	247	r 240	r 244	256	135	147	r 153	r 137	189
Western Europe	265	308	r 326	r 288	303	469	534	r 571	r 505	640
Other	1	1	r 7	r 3	4	4	6	r 6	r 3	3
Total	758	884	r 922	r 891	935	946	1,071	r 1,134	r 1,025	1,220
Developing:										
Caribbean	27	30	r 31	r 27	31	14	14	13	15	17
Far East	102	121	r 111	r 108	136	80	89	r 103	r 104	111
Near East	13	9	r 10	r 14	34	23	28	36	r 43	48
Northern Africa	29	29	34	r 25	29	20	23	31	33	33
Other Africa	73	81	79	r 83	86	23	21	r 23	r 26	26
Venezuela	18	23	28	r 21	20	5	5	6	r 7	8
Other Latin America	103	125	r 144	r 148	156	38	45	r 52	r 50	52
Other	6	7	r 11	r 8	10	2	5	2	r 2	3
Total	371	425	r 448	r 434	502	205	230	r 266	r 280	298
Centrally planned economy countries:										
U.S.S.R	46	44	48	r 47	57	22	24	18	29	34
Other	46	50	58	r 56	61	48	51	r 59	r 62	67
Total	92	94	106	103	118	70	75	r 77	r 91	101

r Revised.

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 32, No. 1, January 1978, pp. xxv–xxvii.

Table 23.—Distribution of world oil tanker tonnage, by size group

Size group (deadweight tons)	1966		1976			
			In service		Under construction or on order at yearend	
	Million deadweight tons	Percent of total	Million deadweight tons	Percent of total	Million deadweight tons [1]	Percent of total
Under 25,000 [2]	30.0	30.2	17.5	5.5	0.5	1.4
25,000–45,000	25.3	25.5	27.3	8.5	3.4	9.7
45,000–65,000	21.2	21.3	19.9	6.2	1.0	2.8
65,000–125,000	21.8	21.9	54.4	17.0	2.6	7.4
125,000–205,000	1.1	1.1	28.7	8.9	7.1	20.2
205,000–285,000	--	--	138.8	43.3	7.1	20.2
285,000 and over	--	--	34.1	10.6	13.5	38.3
Total	99.4	100.0	[3] 320.7	100.0	35.2	100.0

[1] Excludes 5.8 million deadweight tons of combined carriers.
[2] Includes vessels 2,000 deadweight tons and over for 1966 and 10,000 deadweight tons and over for 1976.
[3] Figure differs from that given in table 19 because of a difference in source.

Source: British Petroleum Co. Ltd. BP Statistical Review of the World Oil Industry. Bayard Press, London, 1966, p. 15; and 1976, p. 14.

Table 24.—Indexes of ocean freight rates

(1970=100)

Year and quarter [1]	Trip charter									
	West Germany tankers	Norway					Dry cargo	Centrally planned economy countries [2] tankers (deadweight tons)		
		Tankers (deadweight tons)								
		30,000 (clean)	30,000 (dirty)	30,000–60,000	60,000–150,000	Over 150,000		Less than 1,100	2,000–8,000	Over 8,000
1973	116	--	--	119	--	--	135	164	158	162
1974	75	106	90	68	44	30	182	245	246	250
1975:										
First quarter	30	44	46	30	18	10	129	163	176	135
Second quarter	46	58	52	36	23	12	116	144	149	134
Third quarter	46	66	59	42	25	15	109	147	145	96
Fourth quarter	39	59	58	43	25	10	114	198	160	134
Annual average	40	54	51	36	22	11	119	175	162	128
1976:										
First quarter	42	58	54	36	22	12	101	174	158	123
Second quarter	36	55	57	47	26	13	114	253	167	137
Third quarter	39	61	53	40	25	14	118	260	183	142
Fourth quarter	48	80	75	53	32	17	117	287	188	140
Annual average	39	60	55	42	26	15	112	234	172	141

	Time charter					Trip/time charter				
	West Germany dry cargo	Norway dry cargo	United Kingdom dry cargo (deadweight tons)			United Kingdom tankers [3] (deadweight tons)				
			9,000–16,000	20,000–40,000	Over 40,000	16,500–24,999	25,000–44,999	45,000–79,999	80,000–160,000	Over 160,000
1973	r 207	177	144	150	129	138	131	129	133	--
1974	248	240	211	182	126	153	143	128	116	87
1975:										
First quarter	143	158	143	103	67	100	100	90	79	66
Second quarter	91	114	124	67	33	102	102	92	78	66
Third quarter	94	122	119	88	35	110	104	95	81	67
Fourth quarter	121	132	141	115	r 44	99	97	86	74	59
Annual average	121	137	132	93	45	105	103	92	79	66
1976:										
First quarter	106	123	116	77	38	98	99	84	75	59
Second quarter	125	150	133	88	59	98	97	86	71	58
Third quarter	122	149	135	96	57	104	95	86	71	56
Fourth quarter	124	146	NA	NA	NA	108	95	83	69	55
Annual average	118	139	NA	NA	NA	101	97	85	72	58

r Revised. NA Not available.
[1] Quarterly figures are as of the last month in the quarter except those for "United Kingdom dry cargo," which are averages for the quarter.
[2] Includes Bulgaria, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.
[3] Indexes represent the trip/time charter of the average freight rate assessments calculated on the basis of rates prevailing during the period.

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 30, No. 9, September 1976, p. xxiii; and V. 31, No. 6, June 1977, p. xxxii.

Table 25.—Commercial ocean traffic through the Panama Canal in terms of number of transits and total cargo moved, by type of vessel

	Tankers	Container cargo ships	Dry bulk carriers	General cargo ships	Other	Total
1975						
Number of transits:						
In ballast:						
Atlantic to Pacific	92	2	153	86	708	1,041
Pacific to Atlantic	551	6	169	190	117	1,033
Total	643	8	322	276	825	2,074
Laden:						
Atlantic to Pacific	849	499	1,873	1,801	687	5,709
Pacific to Atlantic	417	557	1,557	1,868	1,427	5,826
Total	1,266	1,056	3,430	3,669	2,114	11,535
Total in ballast and laden:						
Atlantic to Pacific	941	501	2,026	1,887	1,395	6,750
Pacific to Atlantic	968	563	1,726	2,058	1,544	6,859
Grand total	1,909	1,064	3,752	3,945	2,939	13,609
Cargo moved (thousand metric tons):						
Atlantic to Pacific	16,741	3,727	53,266	10,459	1,249	85,442
Pacific to Atlantic	8,351	5,884	27,083	12,486	3,104	56,908
Total	25,092	9,611	80,349	22,945	4,353	142,350
1976						
Number of transits:						
In ballast:						
Atlantic to Pacific	142	5	328	111	642	1,228
Pacific to Atlantic	431	13	94	97	79	714
Total	573	18	422	208	721	1,942
Laden:						
Atlantic to Pacific	703	553	1,537	1,477	671	4,941
Pacific to Atlantic	417	595	1,474	1,533	1,255	5,274
Total	1,120	1,148	3,011	3,010	1,926	10,215
Total in ballast and laden:						
Atlantic to Pacific	845	558	1,865	1,588	1,313	6,169
Pacific to Atlantic	848	608	1,568	1,630	1,334	5,988
Grand total	1,693	1,166	3,433	3,218	2,647	12,157
Cargo moved (thousand metric tons):						
Atlantic to Pacific	14,413	3,987	41,380	6,507	768	67,055
Pacific to Atlantic	9,284	6,077	24,625	9,100	2,952	52,038
Total	23,697	10,064	66,005	15,607	3,720	119,093

Source: Panama Canal Co. Annual Reports for fiscal years ending June 30 of that stated.

Table 26.—Movement of mineral commodities through the Panama Canal, by direction of movement

(Thousand metric tons)

Commodity	Atlantic to Pacific			Pacific to Atlantic			Total		
	1974	1975	1976	1974	1975	1976	1974	1975	1976
METALS									
Aluminum:									
Bauxite and alumina	1,071	1,174	1,071	671	414	470	1,742	1,588	1,541
Metal, except scrap	76	41	92	51	75	51	127	116	143
Chromium, chromite	53	77	22	247	195	201	300	272	223
Copper:									
Ore and concentrate	36	12	22	669	535	477	705	547	499
Metal, except scrap	17	21	12	402	739	705	419	760	717
Iron and steel:									
Iron ore	591	324	121	2,384	3,290	1,278	2,975	3,614	1,399
Metal:									
Pig iron, steel ingots, and other crude forms, except scrap	221	428	26	71	225	101	292	653	127
Semimanufactures (excluding tinplate)	r 1,762	r 1,327	658	r 5,913	r 8,523	7,111	r 7,675	r 9,850	7,769
Lead:									
Ore and concentrate	6	12	25	194	121	164	200	133	189
Metal, except scrap	15	4	7	168	209	101	183	213	108
Manganese ore and concentrate	172	254	276	146	273	236	318	527	512
Tin:									
Ore and concentrate	2	4	--	61	77	75	63	81	75
Metal (including tinplate)	135	100	83	107	141	66	242	241	149
Zinc:									
Ore and concentrate	262	159	76	726	693	555	988	852	631
Metal, except scrap	28	7	1	81	120	154	109	127	155
Other and unspecified:									
Ores and concentrates	144	250	88	995	920	726	1,139	1,170	814
Metals, except scrap	75	60	16	147	337	154	222	397	170
Metal scrap, all metals	3,512	2,175	1,468	39	51	74	3,551	2,226	1,542
NONMETALS									
Asbestos	81	53	34	63	38	31	144	91	65
Borax	7	7	4	444	491	452	451	498	456
Cement	145	181	207	17	23	18	162	204	225
Clays and clay products:									
Fire clay and kaolin	338	229	207	26	10	21	364	239	228
Brick and tile	75	89	70	98	55	28	173	144	98
Diatomaceous earth	6	6	3	33	21	9	39	27	12
Fertilizer materials:									
Nitrogenous:									
Ammonia compounds	568	600	499	50	168	118	618	768	617
Sodium nitrate	43	29	33	288	358	235	331	387	268
Phosphatic	5,278	5,347	3,315	1	89	53	5,279	5,436	3,368
Potassic	274	295	139	620	479	307	894	774	446
Unspecified	1,371	1,199	758	146	117	162	1,517	1,316	920

See footnotes at end of table.

Table 26.—Movement of mineral commodities through the Panama Canal, by direction of movement—Continued

(Thousand metric tons)

Commodity	Atlantic to Pacific			Pacific to Atlantic			Total		
	1974	1975	1976	1974	1975	1976	1974	1975	1976
NONMETALS—Continued									
Sodium compounds:									
Salt	83	130	467	101	186	140	184	316	607
Caustic soda	642	587	540	11	106	6	653	693	546
Other	119	91	87	5	46	26	124	137	113
Stone, including marble	75	46	16	2	1	2	77	47	18
Sulfur	501	226	106	940	1,148	941	1,441	1,374	1,047
Other: Slag, dross, and similar waste, not metal bearing	46	88	19	39	78	45	85	166	64
MINERAL FUELS AND RELATED MATERIALS									
Carbon black	29	15	33	2	4	3	31	19	36
Coal and coke	18,526	25,186	15,964	629	1,539	1,008	19,155	26,725	16,972
Petrochemicals	564	276	488	426	391	225	990	667	713
Petroleum:									
Crude	6,218	6,500	6,162	10,899	4,527	5,967	17,117	11,027	12,129
Refinery products	12,329	9,466	7,095	3,033	3,795	3,055	15,362	13,261	10,150
Total	r 55,496	r 57,075	40,310	r 30,945	r 30,608	25,551	r 86,441	r 87,683	65,861

r Revised.

Source: Panama Canal Co. Annual Report for fiscal year ending June 30, 1976.

Table 27.—Commercial ocean traffic through the Suez Canal in terms of number of transits, by type of vessel [1]

	Tankers	Combination carriers	Container cargo ships	Dry bulk carriers	General cargo ships	Other	Total
1975 [2]							
In ballast:							
Southbound	r 287	2	--	r 17	r 78	r 47	r 431
Northbound	r 46	--	2	r 15	r 513	r 39	r 615
Total	r 333	2	2	r 32	r 591	r 86	r 1,046
Laden:							
Southbound	r 127	r 7	r 10	r 196	r 2,164	r 103	r 2,607
Northbound	r 233	--	r 16	r 136	r 1,408	r 49	r 1,842
Total	r 360	r 7	r 26	r 332	r 3,572	r 52	r 4,449
Total in ballast and laden:							
Southbound	r 414	r 9	r 10	r 213	r 2,242	r 150	r 3,038
Northbound	r 279	--	r 18	r 151	r 1,921	r 88	r 2,457
Grand total	r 693	r 9	r 28	r 364	r 4,163	r 238	r 5,495
1976							
In ballast:							
Southbound	1,284	73	4	146	146	158	1,811
Northbound	113	1	106	58	1,367	563	2,208
Total	1,397	74	110	204	1,513	721	4,019
Laden:							
Southbound	316	16	199	623	4,933	884	6,971
Northbound	897	20	108	781	3,343	263	5,412
Total	1,213	36	307	1,404	8,276	1,147	12,383
Total in ballast and laden:							
Southbound	1,600	89	203	769	5,079	1,042	8,782
Northbound	1,010	21	214	839	4,710	826	7,620
Grand total	2,610	110	417	1,608	9,789	1,868	16,402

r Revised.
[1] Excludes passenger ships, car carriers, and warships.
[2] Data are for June 5 through Dec. 31, 1975.

Source: Suez Canal Reports, June 1975 through December 1976 (monthly).

Table 28.—Movement of mineral commodities through the Suez Canal, by direction of movement

(Thousand metric tons)

Commodity	Southbound		Northbound		Total	
	1975 [1]	1976	1975 [1]	1976	1975 [1]	1976
METALS						
Aluminum, bauxite	--	--	33	1,577	33	1,577
Chromium metal and ore	--	--	r 141	477	r 141	477
Copper metal and ore	--	--	r 109	925	r 109	925
Iron and steel:						
Iron ore	--	--	r 1,116	6,665	r 1,116	6,665
Metal:						
Pig iron	r 63	667	--	--	r 63	667
Plates and sheets	r 273	1,352	--	--	r 273	1,352
Lead metal and ore	--	--	r 93	280	r 93	280
Manganese ore and concentrate	--	--	r 267	1,180	r 267	1,180
Tin metal and ore	--	--	r 28	207	r 28	207
Titanium ore and concentrate	--	--	r 173	--	r 173	--
Zinc metal and ore	--	--	r 145	416	r 145	416
Other metals and ores	r 1,946	2,294	r 175	729	r 2,121	3,023
NONMETALS						
Cement	r 836	6,168	5	--	r 841	6,168
Fertilizer materials:						
Nitrogenous	r 391	3,390	--	--	r 391	3,390
Phosphatic	r 758	2,076	--	--	r 758	2,076
Potassic	r 147	957	--	--	r 147	957
Unspecified	r 1,525	2,728	r 478	1,890	r 2,003	4,618
Salt	13	52	--	--	13	52
Other, unspecified	r 95	1,809	r 157	12,920	r 252	14,729
MINERAL FUELS AND RELATED MATERIALS						
Coal and coke	r 75	453	r 321	919	r 396	1,372
Petroleum:						
Crude	r 90	753	r 2,700	38,411	r 2,790	39,164
Refinery products	r 1,922	5,787	r 2,609	10,121	r 4,531	15,908
Total	r 8,134	28,486	r 8,550	76,717	r 16,684	105,203

r Revised.
[1] Data are for June 5 through Dec. 31, 1975.

Source: Suez Canal Reports, June 1975 through December 1976 (monthly).

Table 29.—Average nonferrous metal prices in Canada

(U.S. cents per pound unless otherwise specified)

Year and month	Copper [1]	Lead [2]	Zinc [2]	Silver [3]
1974	79.487	20.774	34.381	460.126
1975	62.761	19.945	36.378	440.931
1976:				
January	62.969	18.381	36.763	406.657
February	63.788	18.621	37.241	409.193
March	65.268	19.911	37.529	419.444
April	68.550	21.035	37.617	436.001
May	71.286	23.082	37.747	449.709
June	71.769	23.623	38.003	481.734
July	73.947	24.392	38.058	477.029
August	73.453	24.611	37.551	423.537
September	74.228	24.871	37.947	430.039
October	73.231	25.896	37.577	423.058
November	70.261	25.872	36.779	436.430
December	66.189	25.042	35.599	435.603
Annual average	69.578	22.945	37.368	435.703

[1] Electrolytic wirebar, f.o.b. delivered Canadian points.
[2] Pig lead, Prime Western zinc; producer's prices, carload quantities, communicated by Cominco Ltd.
[3] U.S. cents per troy ounce, average price of Cominco Ltd.

Source: American Bureau of Metal Statistics, Inc. Non-Ferrous Metal Data, 1976, New York, 1977, 143 pp.

Table 30.—Average nonferrous metal prices in the United States

(Cents per pound unless otherwise specified)

Year and month	Aluminum [1]	Copper [2]	Lead [3]	Zinc [4]	Tin [5]	Silver [6]
1974	34.133	[r] 76.649	22.533	35.945	[r] 396.266	470.798
1975	39.786	63.535	21.529	38.959	339.818	441.852
1976:						
January	41.000	63.000	19.000	37.122	287.714	406.265
February	41.000	63.000	19.000	37.000	300.944	408.642
March	41.000	64.057	20.216	37.000	321.870	418.913
April	41.000	68.616	21.933	37.000	331.591	435.552
May	41.000	70.000	22.882	37.000	347.250	448.845
June	44.000	70.000	23.000	37.000	356.080	481.173
July	44.000	74.000	24.245	37.000	390.643	477.357
August	47.091	73.725	24.757	37.000	369.091	423.705
September	48.000	73.725	24.830	37.000	363.560	429.524
October	48.000	71.164	25.745	37.000	366.750	422.510
November	48.000	69.725	25.789	37.000	373.631	436.905
December	48.000	64.873	25.818	37.000	381.771	434.762
Annual average	44.341	68.824	23.102	37.010	349.241	435.346

[r] Revised.
[1] Unalloyed ingot, 99.5%, delivered United States.
[2] Electrolytic copper, domestic refineries, on Atlantic seaboard.
[3] Refined lead, nationwide.
[4] Prime Western slab, f.o.b. East St. Louis.
[5] Straits tin, New York.
[6] Cents per troy ounce, 999 fine, New York.

Source: American Bureau of Metal Statistics, Inc. Non-Ferrous Metal Data, 1976, New York. 1977, 143 pp.

Table 31.—Average nonferrous metal prices in the United Kingdom [1]

(U.S. cents per pound unless otherwise specified)

Year and month	Aluminum [2]	Copper [3]	Lead [4]	Zinc	Tin [5]	Silver [6]
1974	34.69	93.097	26.801	55.973	371.391	470.600
1975	39.46	56.110	18.681	33.792	311.627	441.746
1976:						
January	38.65	54.113	15.239	31.341	283.266	406.734
February	38.60	55.310	15.798	31.267	298.468	408.569
March	37.01	60.283	17.361	32.925	316.442	419.332
April	36.68	68.526	22.113	35.776	323.510	434.468
May	37.39	68.595	21.848	35.028	338.152	446.991
June	36.49	70.279	21.596	33.928	353.054	478.517
July	39.75	74.686	23.115	35.121	385.669	476.174
August	44.72	69.751	21.829	33.529	366.891	426.046
September	45.36	66.219	21.753	32.263	360.445	429.676
October	43.01	58.324	21.051	28.935	360.063	421.953
November	43.02	58.000	20.805	27.335	368.617	436.341
December	44.08	58.432	21.658	29.073	380.989	434.257
Annual average	40.40	64.051	20.502	32.304	349.123	434.922

[1] London Metal Exchange, average settlement prices.
[2] Ingot, 99.5%.
[3] Electrolytic wirebar.
[4] Refined pig lead, 99.97%.
[5] Standard tin.
[6] U.S. cents per troy ounce, 999 fine. Figures are corrected from erroneous data published in given source on the basis of personal communication with the American Bureau of Metal Statistics, Inc.

Source: American Bureau of Metal Statistics, Inc. Non-Ferrous Metal Data, 1976, New York. 1977, 143 pp.

Table 32.—World mineral export price indexes [1]

(1970=100)

Year and quarter	Metal ores	Fuels	All crude minerals
1974	175	577	473
1975	r 206	588	494
1976:			
First quarter	199	628	517
Second quarter	218	610	506
Third quarter	213	610	508
Fourth quarter	NA	NA	511
Annual average	NA	NA	510

r Revised. NA Not available.

[1] All data are from: United Nations. Monthly Bulletin of Statistics, New York. V. 30, No. 12, December 1976, pp. xxv–xxvi; except indexes for 1976 third and fourth quarters and annual average under "All crude minerals," which are from: United Nations. Monthly Bulletin of Statistics, New York. V. 31, No. 10, October 1977, p. xiii.

Table 33.—Analysis of world mineral export price indexes

(1970=100)

Year and quarter	Developed areas		Developing areas	
	Nonferrous base metals	All minerals	Nonferrous base metals	All minerals
1974	149	274	160	555
1975	125	301	109	571
1976:				
First quarter	126	299	108	605
Second quarter	138	299	127	590
Third quarter	145	301	134	591
Fourth quarter	NA	NA	NA	NA
Annual average	NA	NA	NA	NA

NA Not available.

Source: United Nations. Monthly Bulletin of Statistics, New York. V. 30, No. 12, December 1976, pp. xxv–xxvi.

Table 34.—Leading world producers of bauxite

(Gross weight, thousand metric tons)

Country	1974	1975	1976 p
Australia	r 19,994	20,958	24,085
Guinea	7,600	r e 9,140	10,848
Jamaica	15,328	11,571	10,306
U.S.S.R. e [1]	6,120	6,470	6,620
Surinam	6,706	4,928	4,565
Hungary	2,751	2,889	2,918
Greece	2,783	3,244	2,747
Guyana e	r 3,250	r 3,250	2,640
France	r 2,938	2,563	2,330
Yugoslavia	2,370	2,306	2,033
United States	1,980	1,801	1,989
India	r 1,114	1,273	1,436
China, People's Republic of e	970	970	1,100
Brazil	858	969	e 1,000
Total	74,762	72,332	74,617
All others	6,715	5,465	5,065
Grand total	r 81,477	77,797	79,682

e Estimate. p Preliminary. r Revised.

[1] Includes bauxite equivalent of nepheline syenite and alunite ore.

Table 35.—Leading world producers of aluminum

(Thousand metric tons)

Country	1974	1975	1976 p
United States	4,448	3,519	3,857
U.S.S.R.e	1,430	r 1,530	1,600
Japan	1,118	1,013	919
Germany, West	689	678	697
Canada	1,021	887	626
Norway	r 663	595	608
France	393	383	385
United Kingdom	r 293	308	335
Netherlands	252	261	256
Australia	219	214	232
Spain	191	212	214
India	129	167	212
Italy	r 216	190	206
Romania	187	204	200
China, People's Republic of e	150	160	200
Total	11,399	10,321	10,547
All others	1,768	1,787	1,950
Grand total	r 13,167	12,108	12,497

e Estimate. p Preliminary. r Revised.

Table 36.—Leading world producers of mine copper

(Copper content of ore, thousand metric tons)

Country	1974	1975	1976 p
United States 1	1,449	1,282	1,457
Chile	902	828	1,005
U.S.S.R.e 1 2	740	765	800
Canada 1	e 821	734	747
Zambia	698	677	709
Zaire	499	496	445
Poland e	198	r 235	273
Philippines	r 226	226	232
Australia	251	219	217
Peru	212	1 179	1 201
South Africa, Republic of	179	179	197
Papua New Guinea	184	172	176
Yugoslavia	112	115	120
China, People's Republic of e	100	100	100
Total	6,571	6,207	6,679
All others	726	751	776
Grand total	r 7,297	6,958	7,455

e Estimate. p Preliminary. r Revised.
1 Recoverable.
2 Smelter production.

Table 37.—Leading world producers of gold

(Thousand troy ounces)

Country	1974	1975	1976 p
South Africa, Republic of	24,388	22,938	22,936
U.S.S.R.e	7,300	7,500	7,700
Canada	1,698	1,654	1,686
Papua New Guinea	r 667	611	1,229
United States	1,127	1,052	1,048
Rhodesia, Southern e	r 800	r 800	800
Ghana	r 614	524	532
Philippines	r 538	502	501
Australia	r 513	527	498
Dominican Republic	--	195	414
Total	r 37,645	36,303	37,344
All others	r 2,479	2,373	2,539
Grand total	r 40,124	38,676	39,883

e Estimate. p Preliminary. r Revised.

Table 38.—Leading world producers of iron ores, concentrates, and agglomerates (excluding roasted pyrites)

(Thousand metric tons)

Country	1974	1975	1976 p
U.S.S.R	r 224,803	232,803	239,000
Australia	r 96,950	97,653	93,248
Brazil	r 75,502	89,894	e 91,812
United States	85,709	80,132	81,277
China, People's Republic of e	60,000	65,000	65,000
Canada	49,976	46,868	56,990
France	r 54,260	49,647	45,181
India	35,485	41,297	43,015
Sweden	36,153	30,867	30,528
Liberia	23,785	r e 24,000	18,814
Venezuela	26,424	24,772	e 18,200
South Africa, Republic of	11,553	12,298	15,663
Chile	10,271	11,049	10,389
Mauritania	11,666	8,686	9,664
Korea, North e	9,400	9,400	9,500
Total	r 811,937	824,366	828,281
All others	r 85,119	77,185	66,858
Grand total	r 897,056	901,551	895,139

e Estimate. p Preliminary. r Revised.

Table 39.—Leading world producers of crude steel [1]

(Thousand metric tons)

Country	1974	1975	1976 p
U.S.S.R	r 136,206	141,325	144,805
United States	132,195	105,816	116,120
Japan	117,131	102,313	107,399
Germany, West	53,232	40,415	42,415
China, People's Republic of e	27,000	29,000	27,000
Italy	23,803	21,836	23,447
France	27,023	21,530	23,220
United Kingdom	22,426	20,198	22,274
Poland	r 14,556	15,007	15,640
Czechoslovakia	13,640	14,324	14,693
Canada	13,623	13,025	13,136
Belgium	16,230	11,587	12,149
Spain	r 11,473	11,115	10,908
Romania	r 8,848	9,549	e 10,800
India	6,820	7,082	9,461
Brazil	7,507	8,308	9,194
Australia	7,755	7,843	7,774
Total	639,468	580,273	610,435
All others	68,286	66,107	68,376
Grand total	r 707,754	646,380	678,811

e Estimate. p Preliminary. r Revised.
[1] Steel ingots and castings.

Table 40.—Leading world producers of mine lead

(Lead content of ore, thousand metric tons)

Country	1974	1975	1976 p
United States	602	564	553
U.S.S.R.	450	450	470
Australia	375	407	399
Canada	r 301	341	257
Mexico	218	179	200
Peru	r 166	185	169
Yugoslavia	120	127	e 134
Korea, North e	r 120	r 120	120
Bulgaria e	110	r 110	108
China, People's Republic of e	100	100	100
Total	r 2,562	2,583	2,510
All others	854	822	848
Grand total	r 3,416	3,405	3,358

e Estimate. p Preliminary. r Revised.

Table 41.—Leading world producers of manganese ore

(Gross weight, thousand metric tons)

Country	1974	1975	1976 p
U.S.S.R.	r 8,155	8,459	8,500
South Africa, Republic of	4,745	5,769	5,452
Brazil	1,789	2,156	2,200
Australia	r 1,523	1,555	2,154
Gabon	2,064	2,217	2,152
India	r 1,502	1,531	1,689
China, People's Republic of e	1,000	1,000	1,000
Mexico	403	428	423
Ghana	250	409	312
Zaire	288	309	157
Total	r 21,719	23,833	24,039
All others	r 737	732	745
Grand total	r 22,456	24,565	24,784

e Estimate. p Preliminary. r Revised.

Table 42.—Leading world producers of mine nickel

(Thousand metric tons)

Country	1974	1975	1976 p
Canada	269	242	262
U.S.S.R.e	r 125	r 132	140
New Caledonia	135	133	107
Australia	r 46	76	83
Cuba e	r 34	37	37
Greece	29	28	28
Dominican Republic	31	27	24
Total	669	675	681
All others	101	114	123
Grand total	r 770	789	804

e Estimate. p Preliminary. r Revised.

Table 43.—Leading world producers of mine tin

(Tin content of ore, metric tons)

Country	1974	1975	1976 p
Malaysia	68,124	64,364	63,401
U.S.S.R.e	29,500	30,000	31,000
Bolivia	29,498	25,590	29,812
Indonesia	25,021	24,391	22,204
Thailand	20,339	16,406	20,452
China, People's Republic of e	20,000	22,000	20,000
Australia	r 10,481	9,114	10,364
Brazil	4,400	5,000	5,900
Zaire	4,675	4,562	e 4,000
Nigeria	5,455	4,652	3,710
Total	217,493	206,079	210,843
All others	15,387	14,956	14,912
Grand total	r 232,880	221,035	225,755

e Estimate. p Preliminary. r Revised.

Table 44.—Leading world producers of mine zinc

(Zinc content of ore, thousand metric tons)

Country	1974	1975	1976 p
Canada	r 1,240	1,223	e 1,190
U.S.S.R.e	680	690	720
Australia	r 457	501	464
United States	453	426	440
Peru	r 378	385	396
Japan	241	254	260
Mexico	263	289	259
Poland e	200	r 210	216
Korea, North e	162	r 160	168
Sweden	114	111	127
Germany, West	r 117	116	115
Yugoslavia	95	103	107
China, People's Republic of e	100	100	100
Greenland	105	91	e 90
Spain	r 95	85	85
Bulgaria e	80	80	84
Total	4,780	4,824	4,821
All others	1,000	976	1,045
Grand total	r 5,780	5,800	5,866

e Estimate. p Preliminary. r Revised.

Table 45.—Leading world producers of hydraulic cement

(Thousand metric tons)

Country	1974	1975	1976 p
U.S.S.R	r 115,145	122,000	123,968
Japan	73,108	65,517	68,712
United States (including Puerto Rico)	75,195	63,251	67,581
Italy	36,309	34,235	36,323
China, People's Republic of e	25,000	30,000	35,000
Germany, West	35,977	33,516	34,155
France	r 32,340	29,588	29,394
Spain	r 22,239	23,970	25,202
Poland	16,765	18,500	19,800
India	r 14,284	16,234	18,499
Brazil	r 14,915	17,437	16,857
United Kingdom	17,781	16,896	15,300
Mexico	10,595	11,612	12,584
Romania	11,195	11,520	12,548
Turkey	r 8,932	10,855	12,346
Korea, Republic of	8,842	10,129	11,873
Germany, East	r 10,099	10,653	11,345
Total	r 528,721	525,913	551,487
All others	r 174,492	176,292	184,619
Grand total	r 703,213	702,205	736,106

e Estimate. p Preliminary. r Revised.

Table 46.—Leading world producers of diamond [1]

(Thousand carats)

Country	1974	1975	1976 [p]
Zaire	13,611	12,810	11,821
U.S.S.R	9,500	9,700	9,900
South Africa, Republic of	7,510	7,295	7,022
Botswana	2,718	2,397	2,361
Ghana	2,572	2,328	2,283
South-West Africa, Territory of	1,570	1,747	1,694
Total	37,481	36,277	35,081
All others	7,041	4,831	4,645
Grand total	44,522	41,108	39,726

[p] Preliminary.
[1] Gem and industrial grades undifferentiated.

Table 47.—Leading world producers of nitrogenous fertilizer compounds [1]

(Nitrogen content, thousand metric tons)

Country	1974	1975	1976 [p]
United States (including Puerto Rico)	9,158	8,474	9,262
U.S.S.R	[r] 7,209	7,806	8,465
China, People's Republic of [e]	[r] 2,567	[r] 2,909	3,088
Japan	2,138	2,341	1,557
Poland	[r] 1,366	1,458	1,533
India	[r] 1,049	1,187	1,508
France	1,642	1,694	1,354
Romania	854	980	1,292
Germany, West	1,473	1,574	1,259
Netherlands	1,201	1,266	1,153
United Kingdom	[r] 755	997	1,055
Italy	1,129	1,132	1,000
Total	[r] 30,541	31,818	32,526
All others	9,895	10,563	11,350
Grand total	[r] 40,436	42,381	43,876

[e] Estimate. [p] Preliminary. [r] Revised.
[1] Data are for years ending June 30 of that stated.

Table 48.—Leading world producers of phosphate rock [1]

(Thousand metric tons)

Country	1974	1975	1976 [p]
United States	41,446	44,285	44,671
U.S.S.R.[e]	22,505	[r] 24,150	24,200
Morocco	19,721	13,548	15,656
China, People's Republic of [e]	3,000	3,400	3,400
Tunisia	[r] 3,800	3,488	3,301
Togo	2,572	1,161	2,009
South Africa, Republic of	1,419	1,646	1,702
Jordan	691	1,112	1,702
Total	95,154	92,790	96,641
All others	14,859	14,591	10,295
Grand total	[r] 110,013	107,381	106,936

[e] Estimate. [p] Preliminary. [r] Revised.
[1] Includes output of all major crude mineral sources of phosphate.

Table 49.—Leading world producers of marketable potash

(K₂O equivalent, thousand metric tons)

Country	1974	1975	1976 p
U.S.S.R.e	r 6,586	r 7,900	8,500
Canada	r 5,480	5,436	4,996
Germany, East	2,864	3,019	e 3,100
United States	2,315	2,269	2,305
Germany, West	2,620	2,223	2,036
France	r 2,275	2,085	1,738
Total	r 22,140	22,932	22,675
All others	r 1,654	1,881	1,707
Grand total	r 23,794	24,813	24,382

e Estimate. p Preliminary. r Revised.

Table 50.—Leading world producers of salt

(Thousand metric tons)

Country	1974	1975	1976 p
United States (including Puerto Rico)	r 42,217	37,222	40,089
China, People's Republic of e	r 25,401	r 29,940	30,000
U.S.S.R.e	r 13,400	r 13,700	14,000
United Kingdom	8,421	7,776	e 7,900
Germany, West	r 11,321	9,316	7,496
France	6,272	5,538	6,416
Canada	5,447	5,156	5,750
Poland	r 4,700	5,106	5,470
Australia	r 4,683	5,057	5,350
Mexico	r 5,508	5,354	4,591
India	r 5,273	3,331	4,480
Romania	3,923	3,833	4,210
Italy	4,894	4,351	4,013
Spain	2,257	3,132	e 3,200
Netherlands	3,387	2,690	3,026
Germany, East	2,338	2,430	e 2,400
Brazil	1,552	2,145	e 2,200
Bahamas	1,027	1,232	1,491
Argentina	956	1,150	e 1,200
Japan	1,115	1,068	1,021
Colombia	875	926	e 894
Total	r 154,967	150,453	155,197
All others	r 11,309	14,417	12,722
Grand total	r 166,276	164,870	167,919

e Estimate. p Preliminary. r Revised.

Table 51.—Leading world producers of elemental sulfur [1]

(Thousand metric tons)

Country	1974				1975				1976 [p]			
	Native	From pyrite	Byprod-uct	Total	Native	From pyrite	Byprod-uct	Total	Native	From pyrite	Byprod-uct	Total
United States	[2] 8,027	165	3,410	11,602	[2] 7,326	241	3,872	11,439	[2] 6,365	291	4,222	10,878
U.S.S.R. [e]	2,400	3,600	1,900	7,900	2,500	3,700	2,000	8,200	2,500	3,800	2,100	8,400
Canada	--	24	[r] 7,872	[r] 7,896	--	11	7,525	7,536	--	15	[e] 7,279	7,294
Poland	[3] 4,093	--	[r] 303	[r] 4,396	[3] 4,771	--	310	5,081	[3] 4,891	--	315	5,206
Japan	([4])	[r] 626	[r] 2,184	[r] 2,810	--	539	1,951	2,490	--	471	2,177	2,648
Mexico	[r] [2] 2,257	--	[r] 91	[r] 2,348	[2] 2,074	--	142	2,216	[2] 2,054	--	171	2,225
France	--	--	[r] 2,101	[r] 2,101	--	--	1,993	1,993	--	--	1,970	1,970
China, People's Republic of [e]	130	900	120	1,150	130	900	120	1,150	150	900	320	1,370
Germany, West	--	214	[r] 1,091	[r] 1,305	--	221	1,062	1,283	--	233	1,130	1,363
Spain	--	1,808	108	[r] 1,416	--	1,264	107	1,371	--	1,070	128	1,198
Finland	([4])	340	[r] 356	[r] 696	--	[r e] 332	361	693	--	[e] 312	391	703
Iraq	[2] 610	--	50	[r] 660	[2] 600	--	110	710	[2] 610	--	65	675
Italy	61	[r] 514	213	[r] 788	51	423	229	703	37	374	199	610
Iran	20	--	605	625	20	--	475	495	20	--	399	419
Australia	--	[r] 108	[r] 148	[r] 256	--	106	149	255	--	104	166	270
Total	[r] 17,598	[r] 7,799	[r] 20,552	[r] 45,949	17,472	7,737	20,406	45,615	16,627	7,570	21,032	45,229
All others	[r] 171	[r] 2,585	[r] 2,751	[r] 5,507	127	2,373	2,897	5,397	129	2,494	3,022	5,645
Grand total	[r] [3] 17,769	[r] 10,384	[r] 23,303	[r] 51,456	[3] 17,599	10,110	23,303	51,012	[3] 16,756	10,064	24,054	50,874

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Includes all recorded production of sulfur, regardless of its origin or the form in which it is recovered. Thus it includes elemental sulfur, whether mined by conventional methods or by the Frasch process, as well as elemental sulfur and the sulfur content of compounds such as H_2S, SO_2, and H_2SO_4 recovered as a principal product of pyrite mining, as a byproduct of the recovery of crude oil and natural gas, and as a byproduct of oil refining, coal treatment, and metals smelting and/or refining.

[2] Entirely Frasch-process sulfur.

[3] Includes Frasch-process sulfur as follows, in thousand metric tons: Poland: 1974—3,274, 1975—3,817, and 1976—4,341; and grand total: 1974—14,234, 1975—13,957; and 1976—13,368. The balance is mined elemental sulfur.

[4] Revised to none.

Table 52.—Leading world producers of coal (all grades)

(Million metric tons)

Country	1974			1975			1976 p		
	Lignite	Bituminous and anthracite	Total	Lignite	Bituminous and anthracite	Total	Lignite	Bituminous and anthracite	Total
U.S.S.R	161	523	684	164	537	701	172	540	712
United States	14	537	551	18	576	594	23	598	621
China, People's Republic of e	(1)	450	450	(1)	470	470	(1)	480	480
Germany, East	243	1	244	247	1	248	247	(2)	247
Germany, West	126	95	221	123	92	215	135	89	224
Poland	40	162	202	40	172	212	39	179	218
United Kingdom	--	r 110	r 110	--	129	129	--	124	124
Czechoslovakia	r 83	28	r 111	87	28	115	89	28	117
India	3	84	87	3	96	99	4	101	105
Australia	27	63	90	28	67	95	31	e 69	100
South Africa, Republic of	--	66	66	--	69	69	--	77	77
Romania	r 20	8	r 28	20	8	28	20	7	29
Korea, North	(1)	39	39	(1)	40	40	(1)	41	41
Yugoslavia	33	1	34	35	1	36	36	1	37
France	3	23	26	3	22	25	3	22	25
Canada	3	r 18	r 21	4	22	26	5	21	26
Bulgaria	24	(2)	24	28	(2)	28	25	(2)	25
Hungary	23	3	26	22	3	25	22	3	25
Total	r 803	r 2,211	r 3,014	822	2,333	3,155	851	2,380	3,231
All others	r 32	r 90	r 122	35	89	124	42	91	133
Grand total	r 835	r 2,301	3,136	857	2,422	3,279	893	2,471	3,364

e Estimate. p Preliminary. r Revised.
1 Output small; included under "Bituminous and anthracite."
2 Less than ½ unit.

Table 53.—Leading world producers of marketed natural gas

(Billion cubic feet)

Country	1974	1975	1976 p
United States	21,601	20,109	19,952
U.S.S.R	9,201	10,206	11,334
Netherlands	2,957	3,208	3,436
Canada	3,046	3,090	3,097
China, People's Republic of e	1,200	1,400	1,600
United Kingdom	1,230	1,274	1,316
Romania	1,012	1,042	1,136
Iran	787	771	794
Germany, West	713	639	658
Mexico	561	584	578
Italy	540	514	553
Libya	345	383	487
Venezuela	476	450	480
Algeria	199	337	351
Argentina	256	278	291
Germany, East	r 269	260	250
Total	44,393	44,525	46,313
All others	2,786	2,819	3,184
Grand total	r 47,179	47,364	49,497

e Estimate. p Preliminary. r Revised.

Table 54.—Leading world producers of natural gas liquids [1]

(Million 42-gallon barrels)

Country	1974	1975	1976 p
United States	616	596	587
Canada	114	112	105
U.S.S.R.e	83	90	100
Saudi Arabia	r e 50	r e 51	68
Mexico	28	33	34
Venezuela	31	19	25
Total	r 922	901	919
All others	r 109	126	129
Grand total	r 1,031	1,027	1,048

e Estimate. p Preliminary. r Revised.

[1] In addition to the countries listed, the People's Republic of China may also produce natural gas liquids, but available information is inadequate to make reliable estimates of output levels. Every effort has been made to include in this table only those natural gas liquids produced by natural gas processing plants and to exclude natural gas liquids obtained from field treatment facilities, including wellhead separators, because the latter are normally blended with crude oil and thus are included in crude petroleum statistics. In some cases, however, sources do not clearly specify whether data presented represent only output of natural gas processing plants or if they include field output. Thus, some of the figures in this table may include field condensate.

Table 55.—Leading world producers of crude petroleum

(Million 42-gallon barrels)

Country	1974	1975	1976 p
U.S.S.R	3,374	3,609	3,822
Saudi Arabia	r 2,997	2,492	3,054
United States	3,203	3,057	2,976
Iran	2,198	1,953	2,168
Iraq	r 723	826	884
Venezuela	1,086	856	840
Nigeria	823	652	756
United Arab Emirates	616	618	713
Libya	555	551	704
Kuwait	r 831	671	700
China, People's Republic of e	r 475	572	646
Indonesia	502	477	550
Canada	617	521	489
Algeria	368	351	384
Mexico	238	294	327
Qatar	189	159	182
Kuwait-Saudi Arabia Neutral Zone	198	181	172
Australia	140	150	153
Argentina	151	144	146
Oman	106	125	134
Egypt	r 53	84	120
Romania	108	109	110
Norway	13	69	102
United Kingdom	3	8	89
Gabon	74	82	82
Total	19,641	18,611	20,303
All others	897	891	889
Grand total	20,538	19,502	21,192

e Estimate. p Preliminary. r Revised.

Table 56.—Leading world producers of petroleum refinery products

(Million 42-gallon barrels)

Country	1974	1975	1976 p
United States (including Puerto Rico and the Virgin Islands)	5,019	5,091	5,479
U.S.S.R	2,814	2,925	3,037
Japan	1,701	1,616	1,681
France	950	809	902
Germany, West	850	726	820
Italy	905	740	795
United Kingdom	820	690	723
China, People's Republic of e	r 422	r 475	646
Canada	646	624	625
Netherlands	479	423	480
Spain (including the Canary Islands)	332	317	376
Venezuela	446	317	360
Brazil	296	330	348
Mexico	236	248	274
Saudi Arabia [1]	234	158	258
Iran	230	251	255
Netherlands Antilles	282	221	226
Australia	207	209	216
Belgium	221	214	213
Kuwait [1]	133	144	173
India	148	161	168
Argentina	170	158	166
Total	r 17,541	16,847	18,221
All others	r 2,889	2,827	3,049
Grand total	20,430	19,674	21,270

e Estimate. p Preliminary. r Revised.

[1] Includes the country's share of production from the Kuwait-Saudi Arabia Neutral Zone.

Table 57.—Major world trade in

(Thousand

Source country	Production [2]	Exports of source country [3]	Austria	Canada	France	West Germany	Italy
Bauxite:							
Australia	20,958	NA	--	--	558	2,758	1,465
Dominican Republic	754	e 754	--	--	--	--	--
France	2,563	46	--	--	XX	11	7
Ghana	320	320	--	--	--	98	--
Greece	3,244	1,595	--	--	112	55	--
Guinea	9,140	NA	--	1,142	655	780	208
Guyana	3,250	2,161	--	821	70	70	22
Haiti	522	e 522	--	--	--	11	--
Hungary	2,889	603	--	--	--	--	--
India	1,273	14	--	--	--	--	--
Indonesia	993	973	--	--	--	--	25
Jamaica	11,571	5,500	--	--	--	--	--
Malaysia	704	649	--	--	--	--	--
Sierra Leone	716	NA	--	333	--	312	2
Surinam	4,928	NA	--	104	22	54	13
United States	1,801	19	--	17	--	--	--
Yugoslavia	2,306	1,283	--	--	--	32	13
Other and unspecified	9,865	NA	19	4	39	32	99
Total	77,797	NA	19	2,421	1,456	4,213	1,854
Alumina:							
Australia	5,127	4,514	--	404	1	135	24
Canada	1,134	24	--	XX	--	(6)	1
France	1,094	368	--	(6)	XX	2	25
Germany, West	1,246	339	7	35	6	XX	11
Greece	475	NA	--	--	--	--	--
Guinea	643	NA	--	--	--	17	--
Guyana	311	325	--	22	--	--	--
Hungary	775	686	--	--	--	--	(6)
Italy	e 742	364	--	--	--	208	XX
Jamaica	2,258	2,370	--	79	--	--	--
Japan	1,565	57	--	--	--	--	--
Surinam	1,148	NA	--	9	--	106	--
United States	5,135	933	--	212	2	4	1
Yugoslavia	283	74	--	--	--	--	--
Other and unspecified	4,157	43	[8] 187	--	3	2	5
Total	26,093	NA	194	761	12	474	67

e Estimate. NA Not available. XX Not applicable.

[1] Data on bauxite production are on a dry equivalent basis for a number of countries, and as such may be reported on a different basis than data on bauxite trade, which almost universally are on a gross weight basis. Data on alumina production are generally for output prior to calcination, while data on alumina trade include aluminum hydroxide and thus may not be exactly comparable.

[2] As reported in the "Bauxite and alumina" chapter of Volume I of the Minerals Yearbook, but on a metric ton basis.

[3] Data are compiled from official export statistics of source countries.

bauxite and alumina in 1975 [1]

metric tons)

Imports of destination [4]								
Japan	Netherlands	Norway	Spain	Sweden	United Kingdom	United States [5]	U.S.S.R.	Selected others
2,940	--	--	--	13	--	94	--	67
--	--	--	--	--	--	754	--	--
--	--	--	1	(6)	--	--	--	--
--	--	--	14	--	224	--	--	--
4	141	3	42	39	40	26	[7] 608	[7] 550
--	--	--	--	--	--	2,640	--	--
48	7	--	42	11	--	559	--	6
--	--	--	--	--	--	503	--	--
--	--	--	--	--	--	--	--	--
(6)	--	--	1	--	--	--	--	--
985	--	--	--	--	--	--	--	--
--	--	--	--	--	--	5,483	--	--
590	--	--	--	--	--	--	--	--
--	--	--	--	--	--	27	--	--
9	1	3	17	--	--	1,952	--	--
11	--	--	--	--	--	XX	--	--
--	--	--	1	--	--	--	[7] 950	[7] 297
13	4	--	1	5	32	30	--	7
4,600	153	6	119	68	296	12,068	1,558	927
546	20	198	--	--	2	1,954	--	--
--	--	25	1	(6)	--	19	--	--
1	159	--	97	(6)	--	10	--	--
1	53	16	3	48	4	4	--	--
--	119	--	62	--	--	--	--	--
--	--	18	166	--	--	--	--	(6)
--	--	69	--	--	69	20	[7] 93	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	26	50	--
--	--	405	123	123	449	707	--	--
XX	(6)	--	(6)	--	--	--	--	--
7	218	237	--	44	--	442	--	--
3	(6)	225	(6)	1	4	XX	--	(6)
--	--	--	--	--	--	--	[7] 55	[7] 19
3	2	77	4	4	30	(6)	--	4
561	571	1,270	456	220	558	3,182	198	23

[4] Unless otherwise specified, data are compiled from official import statistics of destinations, and as such are incomplete but are believed to account for the great majority of total world movement of bauxite and alumina. Countries selected are major world aluminum producers that depend upon imports of bauxite and/or alumina for a significant share of their raw material requirements, plus a few minor countries for which data are readily available.

[5] Includes the Virgin Islands.

[6] Less than ½ unit.

[7] Figure represents exports of source country.

[8] Figure represents difference between reported total and reported detail.

Table 58.—Major world trade in iron ores, concentrates, and agglomerates (excluding roasted pyrite) in 1975 [1]

(Thousand metric tons)

Source country	Exports of source country [2]	Imports of principal destination [3]							
		Canada	United States	Other Western Hemisphere [4]	Belgium-Luxembourg	Czechoslovakia [5]	France	West Germany	Hungary
Algeria	1,500	--	--	--	--	248	12	91	--
Angola	[6] 5,600	--	216	--	--	(5)	401	602	--
Australia	[7] 80,363	--	816	1,201	2,270	(5)	1,675	6,412	--
Brazil	[8] 72,522	690	7,646	--	1,944	659	3,490	11,024	4
Canada	36,060	XX	19,418	299	--	(5)	529	4,065	--
Chile	10,080	--	947	--	--	(5)	--	57	--
France	15,991	--	--	--	10,802	(5)	XX	2,624	--
India	22,796	--	167	--	--	477	--	982	208
Liberia	18,401	(9)	2,536	--	916	496	1,994	6,196	--
Malaysia	94	--	--	--	--	(5)	--	--	--
Mauritania	8,673	--	--	--	921	(5)	2,164	603	--
Norway	3,154	33	54	--	--	(5)	--	1,160	--
Peru	4,896	--	1,576	34	--	(5)	444	593	--
Philippines	1,322	--	14	--	--	(5)	--	--	--
Sierra Leone	[6] 1,454	--	--	--	--	(5)	--	615	--
South Africa, Republic of	[6] 3,337	--	131	--	--	(5)	--	297	--
Spain	1,960	--	--	--	--	(5)	311	879	--
Swaziland	[7] 1,960	--	--	--	--	(5)	--	--	--
Sweden	17,620	128	185	(9)	4,919	419	1,646	5,762	--
U.S.S.R	43,626	--	269	--	--	12,222	25	170	4,049
United States	2,578	3,980	XX	17	--	(5)	--	--	--
Venezuela	[7] 20,129	--	13,348	--	--	(5)	424	1,878	--
Other	[10] 3,940	14	57	20	--	(5)	10	315	--
Unspecified	XX	--	114	(9)	3,748	281	44	--	--
Total	378,056	1,845	47,494	1,571	25,520	14,802	13,169	44,320	4,261

	Italy	Netherlands	Poland [5]	Romania [5]	United Kingdom [5]	Other Europe [11]	Japan	Other Asia and Pacific [12]	Total listed imports
Algeria	51	--	(5)	(5)	(5)	105	--	--	507
Angola	--	--	(5)	(5)	(5)	51	1,431	--	2,701
Australia	2,084	688	(5)	(5)	858	907	63,253	609	80,773
Brazil	3,094	1,769	810	[13] 1,449	2,205	3,595	23,460	--	61,839
Canada	1,992	930	(5)	(5)	3,061	986	3,900	15	35,195
Chile	--	--	(5)	(5)	(5)	--	8,057	--	9,061
France	(9)	--	(5)	(5)	(5)	5	--	--	13,431
India	--	140	578	[13] 2,406	(5)	--	16,812	733	22,503
Liberia	2,831	1,082	(5)	(5)	505	1,128	528	--	18,212
Malaysia	--	--	(5)	(5)	(5)	--	121	33	154
Mauritania	1,313	371	(5)	(5)	1,609	640	975	--	8,596
Norway	--	--	490	(5)	1,639	251	--	--	3,627
Peru	--	--	(5)	(5)	211	--	2,732	245	5,835
Philippines	--	--	(5)	(5)	(5)	--	1,513	2	1,529
Sierra Leone	--	--	(5)	(5)	(5)	--	907	--	1,522
South Africa, Republic of	121	--	(5)	(5)	68	196	1,702	--	2,515
Spain	(9)	391	(5)	(5)	150	62	--	--	1,793
Swaziland	--	--	(5)	(5)	(5)	--	1,725	--	1,725
Sweden	73	1,537	2,250	(5)	2,242	1,330	--	--	20,491
U.S.S.R	1,686	--	11,106	[13] 6,288	969	5,454	1,243	--	43,481
United States	(9)	--	(5)	(5)	(5)	51	(9)	1	4,049
Venezuela	2,161	138	105	(5)	1,803	942	--	--	20,980
Other	240	324	54	(5)	435	104	3,389	40	[14] 4,816
Unspecified	3	--	30	736	29	791	--	--	5,776
Total	15,649	7,370	15,423	10,879	15,784	16,598	131,748	1,678	371,111

e Estimate. XX Not applicable.

[1] Discrepancies between reported exports of a source country and the total reported imports of the corresponding destinations are generally owing to (1) the time lag between shipment and receipt, and (2) the fact that the latter totals are incomplete, representing only the imports of the destinations listed.

[2] Unless otherwise specified, data are compiled from official export statistics of source countries.

[3] Unless otherwise specified, data are compiled from official import statistics of destinations.

[4] Includes the following countries, with total reported imports of each in thousand metric tons: Argentina—1,520, Brazil—less than ½ unit, Mexico—34, and Venezuela—17.

[5] Official import statistics for Czechoslovakia, Poland, Romania, and the United Kingdom do not fully distribute total imports by country of origin and therefore do not clearly indicate whether shipments were received from any of the source countries where this footnote has been entered.

[6] Exports not available. Production reported in lieu of exports because all or nearly all output is exported.

[7] Compiled from official mineral statistics publication of source country rather than official trade return.

[8] Includes pyrite.

[9] Less than ½ unit.

[10] Sum of (1) reported exports of the following countries, in thousand metric tons: Austria—1, Belgium-Luxembourg—3, Bolivia—20, Denmark—13, West Germany—5, Hong Kong—165, Italy—12, the Republic of Korea—62, Mexico—14, Morocco—214, the Netherlands—96, New Zealand—2,352, Tunisia—296, and Yugoslavia—30; and (2) apparent exports (as measured by imports of trading partner countries) of the following countries, in thousand metric tons (trading partner countries in parentheses): Indonesia—282 (Japan only), North Korea—203 (Japan only), and Mozambique—172 (Japan only). In addition to the preceding countries, Switzerland reported exports of less than ½ unit.

[11] Includes the following countries, with total reported imports of each in thousand metric tons: Austria—2,578, Bulgaria—1,687, Denmark—1, Finland—1,206, East Germany—2,818, Greece—787, Norway—38, Portugal—385, Spain—6,136, Sweden—319, Switzerland—45, and Yugoslavia—598.

[12] Includes the following countries with total reported imports of each in thousand metric tons: Australia—17, the Republic of Korea—1,494, Malaysia—less than ½ unit, Singapore—24, Taiwan—143.

[13] Compiled from official export statistics of source country.

[14] Includes the following countries, with reported exports of each in thousand metric tons: Belgium-Luxembourg—97, Bolivia—20, Denmark—9, Finland—1, East Germany—20, Greece—6, Hong Kong—167, Hungary—57, Indonesia—292, Iran—4, Italy—9, Japan—87, North Korea—203, the Republic of Korea—62, Libya—58, Morocco—130, Mozambique—172, the Netherlands—356, New Zealand—2,503, Nigeria—33, Panama—116, Portugal—129, Tunisia—270, and the United Kingdom—15.

Table 59.—Major world trade in steel ingots and

(Thousand

Source	North America			Europe		
	Canada	United States	Latin America [2]	EEC	EFTA	Other market economy countries
North America:						
Canada [6]	XX	907.9	136.0	62.3	1.2	8.3
United States	713.8	XX	1,000.0	116.7	31.1	56.5
Total	713.8	907.9	1,136.0	179.0	32.3	64.8
Europe:						
Market economy countries:						
EEC:						
Belgium-Luxembourg	68.0	437.0	640.0	8,023.0	672.0	478.0
Denmark	--	1.0	3.7	74.6	194.5	3.1
France	140.1	546.8	337.5	3,760.3	597.1	641.2
Germany, West [7]	95.6	921.2	769.1	6,492.5	1,564.0	1,063.0
Italy	41.8	416.3	799.1	1,563.1	250.3	568.8
Netherlands [8]	.5	409.0	99.9	2,130.4	383.3	108.1
United Kingdom	125.6	474.8	206.6	722.7	299.8	252.1
Subtotal	471.6	3,206.1	2,855.9	22,766.6	3,961.0	3,114.3
EFTA:						
Austria	2.5	13.4	18.5	914.0	233.0	155.0
Finland	(9)	7.7	(9)	138.1	251.8	(9)
Norway	.1	1.2	5.4	363.0	129.6	67.9
Portugal	.2	.3	1.9	2.1	4.5	2.2
Sweden	26.9	74.0	41.8	931.5	222.3	186.6
Switzerland	.7	1.1	2.7	151.6	49.3	11.8
Subtotal	30.4	97.7	70.3	2,500.3	890.5	423.5
Other:						
Greece [6]	(9)	10.5	(9)	2.6	8.6	167.1
Spain	1.6	155.1	58.5	480.7	23.9	114.9
Yugoslavia	.8	5.5	(9)	38.6	4.6	.7
Subtotal	2.4	171.1	58.5	521.9	37.1	282.7
Centrally planned economy countries:						
Bulgaria	--	--	34.7	169.9	21.4	110.6
Czechoslovakia	38.4	10.7	3.5	672.5	77.5	454.3
Germany, East	NA	NA	NA	NA	NA	NA
Hungary	1.0	--	18.0	148.0	46.0	364.0
Poland	5.6	32.8	106.9	105.6	97.3	227.4
Romania	NA	NA	NA	NA	NA	NA
U.S.S.R	--	--	250.3	12.9	4.3	315.7
Subtotal	45.0	43.5	413.4	1,108.9	246.5	1,472.0
Total	549.4	3,518.4	3,398.1	26,897.7	5,135.1	5,292.5
Africa: Republic of South Africa [6]	2.0	3.5	27.7	26.3	1.1	3.2
Far East and South Asia: Japan	318.4	5,125.6	3,359.3	1,581.6	646.3	1,351.1
Oceania: Australia [10]	8.4	66.4	347.2	326.0	.2	43.1
Grand total	1,592.0	9,621.8	8,268.3	29,010.6	5,815.0	6,754.7

NA Not available. XX Not applicable.

[1] Because some countries do not report destinations for a portion of exports (see "Unallocated"), figures given for distribution of those countries' exports by geographical area are not exactly correct. However, such unallocated portions are sizable only in the case of the centrally planned economy countries and the Republic of South Africa.

[2] Includes all Western Hemisphere areas except Canada and the United States.

[3] Consists of Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and the U.S.S.R.

[4] Consists of Bahrain, Cyprus, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, the United Arab Emirates, the People's Democratic Republic of Yemen, and the Yemen Arab Republic.

semimanufactures in 1975, by geographical area

metric tons)

Destination [1]								
			Far East and South Asia					
Centrally planned economy countries [3]	Africa	Near East [4]	Japan	Other market economy countries	Centrally planned economy countries [5]	Oceania	Unallocated	Total
14.5	20.6	33.3	0.5	69.9	4.1	6.6	--	1,265.2
9.9	207.6	338.0	3.9	199.6	82.4	13.4	5.9	2,778.8
24.4	228.2	371.3	4.4	269.5	86.5	20.0	5.9	4,044.0
338.0	482.0	660.0	--	45.0	67.0	3.0	711.0	12,624.0
2.4	.6	4.2	--	.5	5.1	--	.2	289.9
285.3	866.4	517.8	.2	67.3	102.8	20.5	301.1	8,184.4
1,207.2	568.0	644.5	2.0	201.0	465.0	12.8	2,246.3	16,252.2
250.6	779.9	828.4	.3	24.4	89.8	3.4	647.0	6,263.2
111.7	56.0	45.7	--	16.9	29.6	.5	40.2	3,431.8
66.5	268.5	341.0	.3	190.1	29.6	76.8	135.4	3,189.8
2,261.7	3,021.4	3,041.6	2.8	545.2	788.9	117.0	4,081.2	50,235.3
343.0	19.3	63.0	.1	1.2	1.8	(9)	201.1	1,965.9
1.3	.1	13.3	--	.1	10.3	(9)	18.2	440.9
6.7	3.5	6.1	(9)	1.4	(9)	(9)	1.5	586.4
6.3	5.0	.8	(9)	.2	(9)	(9)	6.3	29.8
114.2	14.7	10.1	2.1	15.1	12.4	8.0	9.4	1,669.1
4.1	6.2	3.2	(9)	.7	.1	(9)	7.7	239.2
475.6	48.8	96.5	2.2	18.7	24.6	8.0	244.2	4,931.3
19.5	80.1	28.4	--	16.8	(9)	(9)	--	333.6
132.8	193.9	320.0	--	1.5	59.8	.2	17.7	1,560.6
153.3	.9	.3	--	.6	4.3	(9)	109.2	318.8
305.6	274.9	348.7	--	18.9	64.1	.2	126.9	2,213.0
289.5	3.0	158.7	--	1.1	3.4	--	--	792.3
1,385.7	138.6	287.3	--	41.2	108.1	--	--	3,217.8
NA	NA	NA	NA	NA	NA	NA	4,015.0	4,015.0
305.0	16.0	115.0	--	23.0	12.0	--	--	1,048.0
832.4	3.9	11.0	--	17.2	45.1	--	--	1,485.2
NA	NA	NA	NA	NA	NA	NA	1,853.0	1,853.0
6,237.2	112.4	166.6	--	57.5	90.1	--	578.1	7,825.1
9,049.8	273.9	738.6	NA	140.0	258.7	NA	6,446.1	20,236.4
12,092.7	3,619.0	4,225.4	5.0	722.8	1,136.3	125.2	10,898.4	77,616.0
--	--	55.3	(9)	6.2	--	.5	198.2	324.0
1,212.1	1,278.6	4,723.5	XX	5,886.6	2,890.9	565.1	3.2	28,942.3
98.6	16.3	83.5	51.8	71.5	360.5	253.7	--	1,727.2
13,427.8	5,142.1	9,459.0	61.2	6,956.6	4,474.2	964.5	11,105.7	112,653.5

[5] Consists of the People's Republic of China, North Korea, and Vietnam. Mongolia is included under "Other market economy Far East and South Asia," owing to its inseparability from this group in source.
[6] Excludes exports of wheels, tires, and axles.
[7] Excludes exports to East Germany.
[8] Excludes exports to Belgium-Luxembourg.
[9] Less than ½ unit.
[10] Data are for year ending June 30, 1975.

Sources: United Nations. Statistics of World Trade in Steel, 1975, New York. 1976, 66 pp.
United Nations Economic Commission for Europe. Quarterly Bulletin of Steel Statistics for Europe, 1976, New York. V. 27, No. 2, 1976, 62 pp.

Table 60.—Major world trade in unrefined and refined unwrought copper in 1975 [1]

(Thousand metric tons)

Source	Destination							
	Belgium-Luxembourg	Brazil	People's Republic of China	Czechoslovakia	France	West Germany	Italy	Japan
Belgium-Luxembourg	XX	3	--	1	94	41	7	--
Canada	11	5	--	--	22	47	15	1
Chile [2]	11	45	14	--	45	156	58	32
Germany, West	19	1	--	1	8	XX	5	--
Peru [2]	11	1	29	--	(3)	9	1	5
U.S.S.R	6	--	--	39	7	12	2	(3)
United Kingdom	3	1	--	--	2	11	8	1
United States	13	22	--	--	21	31	20	3
Yugoslavia	--	--	1	--	--	2	8	--
Zaire [2]	277	--	--	--	27	13	61	13
Zambia [2]	14	16	17	--	64	101	79	114
Other [4]	29	(3)	10	(3)	36	69	7	25
Total	394	94	71	41	326	492	271	194

Source	Netherlands	Spain	Sweden	Switzerland	United Kingdom	United States	Other and unspecified	Total
Belgium-Luxembourg	24	11	17	8	34	1	14	255
Canada	33	1	9	5	94	65	12	320
Chile [2]	9	20	21	3	105	53	[5] 112	684
Germany, West	9	(3)	1	1	25	(3)	25	95
Peru [2]	--	--	--	--	7	40	22	125
U.S.S.R	35	--	8	--	1	--	[6] 96	206
United Kingdom	1	3	3	(3)	XX	1	9	43
United States	14	(3)	1	1	14	XX	18	158
Yugoslavia	--	--	--	--	11	22	3	47
Zaire [2]	13	--	--	--	6	--	54	464
Zambia [2]	6	4	15	11	144	(3)	[7] 50	635
Other [4]	8	(3)	3	3	28	4	22	244
Total	152	39	78	32	469	186	437	3,276

XX Not applicable.

[1] Unless otherwise specified, data are compiled from official export statistics of source countries.

[2] World Bureau of Metal Statistics. World Metal Statistics. V. 31, No. 7, 1978, 108 pp.

[3] Less than ½ unit.

[4] Includes the following countries, with total exports of each in thousand metric tons: Australia—109, Austria—11, Denmark—less than ½ unit, Finland—14, France—8, Italy—6, Japan—22, Netherlands—28, Norway—25, Spain—17, and Switzerland—4.

[5] Includes 36,700 tons to Argentina and 18,000 tons to East Germany.

[6] Includes 33,121 tons to Hungary and 5,641 tons to Romania.

[7] Includes 18,036 tons to Yugoslavia.

Table 61.—Major world trade in lead ore and concentrate [1]

(Thousand metric tons of contained metal unless otherwise specified)

Destination	Source								
	North America	Latin America [2]	Western Europe [3]	Eastern Europe [4]	Africa	Asia	Oceania	Origin not reported by continent	Total
1975									
United States	26.3	32.8	5.9	--	--	--	14.4	--	79.4
Western Europe:									
Belgium-Luxembourg [5]	12.1	r 22.0	r 27.2	6.4	r 8.8	3.1	10.5	r 0.2	r 90.3
France	r 27.9	r 1.3	r 49.3	--	r 12.2	--	--	r.2	r 90.9
Germany, West	44.4	r 8.0	44.5	3.2	17.3	.9	.3	r.2	118.8
United Kingdom	r 15.8	4.9	r 2.8	--	r 1.8	--	4.2	r.1	r 29.6
Total r	100.2	36.2	123.8	9.6	40.1	4.0	15.0	.7	329.6
Japan	74.1	26.0	--	--	--	12.2	6.2	--	118.5
Grand total r	200.6	95.0	129.7	9.6	40.1	16.2	35.6	.7	527.5
1976									
United States	25.1	29.4	4.6	--	--	--	10.2	--	69.3
Western Europe:									
Belgium-Luxembourg [5 6]	9.8	31.6	NA	NA	NA	NA	NA	25.0	66.4
France	24.1	1.0	28.8	--	8.6	--	2.0	.1	64.6
Germany, West	23.6	6.6	49.3	1.8	14.0	.5	.2	--	96.0
United Kingdom	4.5	1.8	3.9	--	1.0	1.5	--	--	12.7
Total	62.0	41.0	82.0	1.8	23.6	2.0	2.2	25.1	239.7
Japan [7]	59.1	20.8	--	--	--	7.3	4.6	--	91.8
Grand total	146.2	91.2	86.6	1.8	23.6	9.3	17.0	25.1	400.8

r Revised. NA Not available.

[1] Imports of countries other than those listed are believed to be generally smaller than those of listed countries.

[2] Includes Mexico.

[3] Includes Yugoslavia.

[4] Includes Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and the U.S.S.R.

[5] Gross weight of ore.

[6] January through June only.

[7] January through September only.

Source: Monthly Bulletin of the International Lead and Zinc Study Group. Lead and Zinc Statistics. V. 17, No. 4, 1977, p. 24.

Table 62.—World trade in

(Gross weight,

Destination	Angola	Australia	Brazil	People's Republic of China	Gabon	Ghana	India
Argentina	--	--	56	--	--	20	--
Belgium-Luxembourg	14	11	20	--	--	29	--
Brazil	--	--	XX	--	14	--	--
Bulgaria [2]	NA	NA	NA	NA	NA	NA	14
Canada	--	--	35	--	--	--	--
Czechoslovakia	NA	NA	22	NA	NA	39	37
France	--	--	--	--	532	--	--
Germany, East [2]	NA	NA	NA	NA	NA	NA	NA
Germany, West	--	161	79	1	22	--	--
Italy	--	--	35	1	106	--	--
Japan	--	655	22	45	173	47	671
Korea, North [2]	NA	NA	NA	NA	NA	NA	12
Korea, Republic of	--	5	4	--	--	--	23
Netherlands	NA	NA	NA	NA	NA	NA	NA
Norway	--	97	248	--	248	68	--
Poland	--	--	--	--	--	--	--
Singapore	--	--	--	--	NA	6	--
Spain	--	23	54	--	--	54	--
Sweden	--	--	--	--	12	--	--
Taiwan	--	12	4	--	--	--	33
United Kingdom	--	--	79	--	59	10	--
United States	--	155	574	--	443	--	--
Yugoslavia	--	--	--	--	29	6	--
Other [3]	--	--	14	1	16	11	--
Total reported imports [4]	14	1,119	1,246	48	1,654	290	790
Total reported exports [5]	NA	NA	1,558	NA	[7] 2,205	NA	745

NA Not available. XX Not applicable.

[1] Unless otherwise specified, data are compiled from official import statistics of destinations.

[2] Compiled from official export statistics of source countries.

[3] Includes the following destination countries, with total imports of each in thousand metric tons: Australia—less than ½ unit, Austria—less than ½ unit, Denmark—3, Greece—2, Hong Kong—1, India—5, Ireland—27, Kenya—1, Mexico—1, Morocco—less than ½ unit, the Philippines—3, Portugal—51, Thailand—less than ½ unit, and Venezuela—less than ½ unit.

[4] Sum of figures listed for individual destinations, including those covered by footnote 2.

[5] Includes the following source countries, with total imports of each in thousand metric tons: Belgium-Luxembourg—33, Bolivia—1, the Congo (probable actual origin Gabon or Zaire)—127,

manganese ore in 1975 [1]

thousand metric tons)

Source								
Malaysia	Mexico	Morocco	Republic of South Africa	U.S.S.R.	Zaire	Other	Unspecified	Total
--	--	--	--	--	--	--	2	78
--	--	--	153	1	72	12	1	313
--	2	--	--	--	--	1	1	18
NA	NA	NA	NA	126	NA	NA	NA	140
--	--	--	73	--	16	31	--	155
NA	NA	[2] 2	NA	336	NA	--	20	456
--	50	25	544	--	--	6	1	1,158
NA	NA	NA	NA	179	NA	NA	NA	179
--	--	11	429	--	--	29	1	733
--	--	3	146	3	--	21	--	315
87	130	--	1,607	178	9	116	--	3,740
NA	NA	NA	NA	20	NA	NA	NA	32
11	--	--	--	--	--	--	1	44
NA	NA	NA	NA	NA	NA	2	45	47
--	--	--	341	50	20	--	1	1,073
--	--	--	--	496	--	60	--	556
--	--	--	NA	--	NA	9	9	24
--	--	9	168	--	--	129	--	437
--	--	--	6	16	--	1	--	35
11	--	--	--	--	--	19	--	79
--	1	13	65	--	1	25	--	253
--	47	--	187	--	21	--	1	1,428
--	--	--	--	29	--	13	1	78
--	--	--	31	2	1	31	1	108
109	230	63	3,750	1,436	140	[5] 505	85	11,479
108	194	111	NA	1,411	NA	[8] 319	XX	XX

France—42, West Germany—2, Greece—6, Hungary—18, Indonesia—8, Japan—23, the Netherlands—25, the New Hebrides—47, Norway—2, the Philippines—1, Romania—45, Rwanda (probable actual origin Zaire)—8, Singapore—1, Thailand—28, Turkey—1, the United Kingdom—2, the United States—75, Yugoslavia—6, and unspecified—4.

[6] Actual reported exports of listed source country unless otherwise specified.

[7] Exports reported in a source other than official trade return.

[8] Includes the following source countries, with total reported exports of each in thousand metric tons: Belgium-Luxembourg—9, France—4, West Germany—3, Greece—3, Hungary—NA, Indonesia—8, Japan—4, the Netherlands—26, the New Hebrides—47, Norway—3, the Philippines—2, Romania—NA, Thailand—15, the United Kingdom—4, the United States—186, and Yugoslavia—5.

Table 63.—Major world trade in lead bullion and refined lead [1]

(Thousand metric tons of contained metal)

Destination	Source								
	North America	Latin America [2]	Western Europe [3]	Eastern Europe [4]	Africa	Asia	Oceania	Origin not reported by continent	Total
1975									
United States	27.4	45.2	16.8	--	1.0	0.1	--	0.6	91.1
Western Europe:									
France [5]	--	--	27.6	0.6	.7	--	--	.3	29.2
Germany, West	2.3	--	64.7	.4	.5	32.3	16.5	--	116.7
Netherlands	--	2.2	24.2	.2	--	3.0	11.7	.2	41.5
Switzerland	3.8	1.0	8.3	--	--	.9	.6	--	14.6
United Kingdom	41.3	--	--	--	--	.1	153.7	4.1	199.2
Other	1.3	--	15.3	--	2.9	--	--	--	19.5
Total	48.7	3.2	140.1	1.2	4.1	36.3	182.5	4.6	420.7
Japan	2.3	5.6	--	--	1.8	9.2	1.5	--	20.4
Grand total	78.4	54.0	156.9	1.2	6.9	45.6	184.0	5.2	532.2
1976									
United States	43.9	59.5	22.5	--	2.5	--	5.6	.5	134.5
Western Europe:									
Belgium-Luxembourg	--	--	23.8	--	--	.1	9.5	--	33.4
France	.3	2.1	43.2	--	3.5	3.5	1.0	--	53.6
Germany, West	2.8	.1	75.7	.4	1.2	18.7	6.9	--	105.8
Netherlands [6]	NA	2.4	20.5	--	--	4.6	6.1	.1	33.7
Norway [6]	3.2	.2	7.1	--	--	--	.1	--	10.6
Switzerland [6]	35.8	--	--	--	--	--	197.1	--	232.9
United Kingdom	.2	--	9.5	--	.9	--	--	--	10.6
Total	42.3	4.8	179.8	.4	5.6	26.9	220.7	.1	480.6
Japan	2.2	18.2	--	--	.3	11.5	--	--	32.2
Grand total	88.4	82.5	202.3	.4	8.4	38.4	226.3	.6	647.3

NA Not available.

[1] Imports of countries other than those listed are generally small individually (except those of Eastern European countries, as listed in footnote 4) but in aggregate apparently total about 125,000 tons per year. Total imports of Eastern European countries alone, including trade between countries of this group, apparently total 70,000 tons or more per year.

[2] Includes Mexico.

[3] Includes Yugoslavia.

[4] Includes Bulgaria, Czechoslovakia, East Germany, Poland, and the U.S.S.R.

[5] January through June only.

[6] January through September only.

Table 64.—Major world trade in zinc ore and concentrate [1]

(Thousand metric tons of contained metal unless otherwise specified)

Destination	Source								
	North America	Latin America [2]	Western Europe [3]	Eastern Europe [4]	Africa	Asia	Oceania	Origin not reported by continent	Total
1975									
United States	89.5	32.7	0.3	--	--	5.3	3.7	--	131.5
Western Europe:									
Belgium-Luxembourg [5 6]	358.5	NA	36.8	NA	NA	NA	NA	134.4	529.7
France [7]	16.8	34.9	30.5	--	9.7	3.0	.9	--	95.8
Germany, West	109.6	34.0	74.6	0.6	34.6	7.2	2.5	--	263.1
United Kingdom	2.6	20.9	4.4	--	.9	--	12.5	3.7	45.0
Other [8]	64.1	11.1	67.2	--	--	--	61.6	--	204.0
Total	551.6	100.9	213.5	.6	45.2	10.2	77.5	138.1	1,137.6
Japan	148.6	166.4	--	--	--	54.0	76.8	.8	446.6
Grand total	789.7	300.0	213.8	.6	45.2	69.5	158.0	138.9	1,715.7
1976									
United States	63.4	21.9	.3	--	--	.3	2.1	.1	88.1
Western Europe:									
Belgium-Luxembourg [5 7]	165.8	NA	10.7	NA	NA	NA	NA	99.6	276.1
France	55.9	91.7	74.8	--	30.9	3.6	.6	--	257.5
Germany, West	106.8	32.8	58.5	1.8	47.7	6.5	3.1	7.0	264.2
United Kingdom	15.1	23.1	10.0	--	.4	9.1	--	.1	57.8
Other [8]	10.2	8.8	68.1	--	--	--	67.4	--	154.5
Total	353.8	156.4	222.1	1.8	79.0	19.2	71.1	106.7	1,010.1
Japan [9]	114.7	124.0	--	--	--	37.2	67.3	--	343.2
Grand total	531.9	302.3	222.4	1.8	79.0	56.7	140.5	106.8	1,441.4

NA Not available.

[1] Imports of countries other than those listed are believed to be generally smaller than those of listed countries.

[2] Includes Mexico.

[3] Includes Yugoslavia.

[4] Includes Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and the U.S.S.R.

[5] Gross weight of ore.

[6] January through October only.

[7] January through June only.

[8] Consists of the Netherlands and Norway. Netherlands data is for January through October only for 1975 and January through September only for 1976. Norway data is gross weight of ore.

[9] January through September only.

Source: Monthly Bulletin of the International Lead and Zinc Study Group. Lead and Zinc Statistics. V. 16, No. 4, 1976, p. 25; and V. 17, No. 4, 1977, p. 25.

Table 65.—Major world trade in refined zinc

(Thousand metric tons)

Destination	Source								
	North America	Latin America [1]	Western Europe [2]	Eastern Europe [3]	Africa	Asia	Oceania	Origin not reported by continent	Total
1975									
United States	164.8	33.3	105.0	0.4	14.0	6.5	20.8	0.3	345.1
Western Europe:									
Denmark	--	--	11.0	--	--	--	--	--	11.0
France [4]	.6	2.5	17.0	2.7	.2	5.5	--	.2	28.7
Germany, West	2.3	2.3	65.3	2.4	1.2	5.3	--	--	78.8
Netherlands	--	.6	20.1	.8	2.4	1.2	--	--	25.1
Sweden	--	1.1	36.1	4.6	.5	.4	--	--	42.7
Switzerland	.7	.1	12.9	.5	1.2	1.3	--	--	16.7
United Kingdom	60.2	.5	96.1	7.8	3.5	1.1	17.2	5.9	192.3
Total	63.8	7.1	258.5	18.8	9.0	14.8	17.2	6.1	395.3
Japan	2.9	2.4	--	1.6	--	19.1	.3	--	26.3
Grand total	231.5	42.8	363.5	20.8	23.0	40.4	38.3	6.4	766.7
1976									
United States	284.0	74.9	207.6	.8	39.2	10.9	29.6	1.2	648.2
Western Europe:									
Belgium-Luxembourg	4.6	.8	14.2	2.5	1.6	4.7	.6	.1	29.1
France	.2	2.2	47.8	4.9	2.2	4.3	--	.3	61.9
Germany, West	2.4	5.5	97.4	2.8	6.5	1.9	--	.4	116.9
Netherlands [5]	NA	1.4	10.6	1.0	3.7	.1	.8	--	17.6
Sweden	--	.1	33.5	4.6	.6	.2	--	.1	39.1
Switzerland [5]	NA	.3	8.8	.3	1.0	.5	.1	--	11.0
United Kingdom	40.9	--	126.1	18.1	2.7	.7	5.5	4.9	193.9
Total	48.1	10.3	338.4	29.2	18.3	12.4	7.0	5.8	469.5
Japan	--	--	--	.1	--	27.3	--	.7	28.1
Grand total	332.1	85.2	546.0	30.1	57.5	50.6	36.6	7.7	1,145.8

NA Not available.
[1] Includes Mexico.
[2] Includes Yugoslavia.
[3] Includes Bulgaria, East Germany, Poland, the U.S.S.R., and unspecified other countries.
[4] January through June only.
[5] January through September only.

Source: Monthly Bulletin of the International Lead and Zinc Study Group. Lead and Zinc Statistics. V. 16, No. 5, 1976, p. 25; and V. 17, No. 5, 1977, p. 25.

Table 66.—World trade in solid fuels, by geographical area [1]

(Thousand metric tons)

Area	Exports		Imports	
	1974	1975	1974	1975
Market economy countries:				
North America [2]	67,156	73,006	17,621	18,085
Caribbean America [3]	41	37	822	914
South America [4]	4	2	3,337	4,508
Europe	38,121	29,203	91,861	87,327
Africa	2,736	3,249	1,824	2,614
Near East [5]	--	--	27	43
Far East [6]	1,184	1,173	66,600	63,947
Oceania [7]	29,663	30,473	175	131
Centrally planned economy countries:				
Europe [8]	83,500	81,026	42,025	41,422
Asia [9]	1,960	1,768	334	330
Total [10]	224,365	219,937	224,626	219,321

[1] Data are based on the general trade system; lignite, lignite briquets, and coke are reduced to standard coal equivalent (SCE) before inclusion; bunker loadings are excluded.
[2] Includes Bermuda, Canada, Greenland, St. Pierre, and the United States.
[3] Includes Mexico, Central America, the Caribbean Islands, Colombia, and Venezuela.
[4] Excluding Colombia and Venezuela.
[5] Includes Bahrain, Cyprus, Iran, Iraq, Israel, Lebanon, Syria, and Turkey.
[6] Includes Afghanistan, Bangladesh, Burma, Cambodia, Hong Kong, India, Indonesia, Japan, the Republic of Korea, Macao, Malaysia, Nepal, Pakistan, the Philippines, Singapore, and Thailand.
[7] Includes Australia, Fiji, New Caledonia, and New Zealand.
[8] Includes Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and the U.S.S.R.
[9] Includes the People's Republic of China, North Korea, Mongolia, and Vietnam.
[10] Totals are adjusted slightly from those reported to equal sum of listed detail.

Source: United Nations. World Energy Supplies 1972–76, New York. Statistical Papers, ser. J, No. 21, 1978, pp. 36–44.

Table 67.—World trade in natural gas [1]

(Billion cubic feet)

Destination	Source									
	Afghanistan	Algeria	Canada	Iran	Libya	Netherlands	U.S.S.R.	United States	Other	Total
1974										
Argentina	--	--	--	--	--	--	--	--	55	55
Austria	--	--	--	--	--	--	r 57	--	r 1	r 58
Belgium-Luxembourg	--	--	--	--	--	r 343	--	--	1	r 344
Canada	--	--	XX	--	--	--	--	r 15	--	r 15
Czechoslovakia	--	--	--	--	--	--	r 83	--	--	r 83
France	--	r 56	--	--	--	r 292	--	--	--	r 348
Germany, East	--	--	--	--	--	--	r 29	--	--	r 29
Germany, West	--	--	--	--	--	r 659	r 12	--	--	r 671
Hungary	--	--	--	--	--	--	--	--	7	7
Italy	--	--	--	--	r 76	(2)	(2)	--	--	r 76
Japan	--	--	--	--	--	--	--	r 48	r 54	r 102
Malaysia (Sarawak)	--	--	--	--	--	--	--	--	5	5
Mexico	--	--	--	--	--	--	--	14	--	14
Poland	--	--	--	--	--	--	r 60	--	--	r 60
Spain	--	--	--	--	r 63	--	--	--	--	r 63
Switzerland	--	--	--	--	--	--	--	--	r 7	r 7
U.S.S.R	r 97	--	--	r 307	--	--	XX	--	--	r 404
United Kingdom	--	r 31	--	--	--	--	--	--	--	r 31
United States	--	r 3	r 1,028	--	--	--	--	XX	r 2	r 1,033
Total	r 97	90	r 1,028	r 307	r 139	r 1,294	r 241	77	r 132	r 3,405
1975										
Argentina	--	--	--	--	--	--	--	--	62	62
Austria	--	--	--	--	--	--	66	--	--	66
Belgium-Luxembourg	--	--	--	--	--	398	--	--	3	401
Canada	--	--	XX	--	--	--	--	10	--	10
Czechoslovakia	--	--	--	--	--	--	130	--	--	130
France	--	102	--	--	--	344	--	--	--	446
Germany, East	--	--	--	--	--	--	117	--	--	117
Germany, West	--	--	--	--	--	904	110	--	--	1,014
Hungary	--	--	--	--	--	--	21	--	7	28
Italy	--	--	--	--	86	175	83	--	--	344
Japan	--	--	--	--	--	--	--	53	186	239
Malaysia (Sarawak)	--	--	--	--	--	--	--	10	--	10
Mexico	--	--	--	--	--	--	89	--	--	89
Poland	--	--	--	--	--	--	--	--	5	5
Spain	--	8	--	--	59	--	--	--	--	67
Switzerland	--	--	--	--	--	--	--	--	7	7
U.S.S.R	101	--	--	338	--	--	XX	--	--	439
United Kingdom	--	34	--	--	--	--	--	--	--	34
United States	--	5	948	--	--	--	--	XX	--	953
Total	101	149	948	338	145	1,821	616	73	270	4,461

r Revised. XX Not applicable.

[1] Data are compiled from official export statistics of source countries.

[2] Revised to none.

Table 68.—World trade in crude petroleum, by geographical area [1]

(Thousand metric tons)

Source	Destination									
	Market economy countries								Centrally planned economy countries of Europe	Total
	North America	Caribbean America	South America	Europe	Africa	Near East	Far East	Oceania		
1974										
Market economy countries:										
North America	r 40,130	130	--	--	--	--	--	--	--	r 40,260
Caribbean America	r 37,280	r 46,290	r 3,620	10,520	--	--	400	--	--	r 98,110
South America	r 2,640	5,010	r 2,620	(2)	--	--	--	--	--	r 10,270
Europe	40	--	--	r 6,480	20	--	--	--	--	r 6,540
Africa	51,230	r 19,840	4,770	r 156,060	5,920	330	8,650	--	1,480	r 248,280
Near East	r 69,500	r 47,330	31,890	r 497,660	26,630	r 28,490	r 266,350	r 12,870	10,970	r 991,690
Far East	13,990	r 5,210	--	--	--	--	r 43,620	750	--	r 63,570
Oceania	--	--	--	--	--	(2)	r 170	r 10	(2)	180
Centrally planned economy countries of Europe	--	5,350	190	18,060	1,030	--	5,050	--	55,530	85,210
Total	r 214,810	r 129,160	r 43,090	r 688,780	33,600	r 28,820	r 324,240	r 13,630	r 67,980	r 1,544,110
1975										
Market economy countries:										
North America	30,830	290	--	--	--	--	--	--	--	31,120
Caribbean America	44,340	31,910	3,350	8,880	--	890	240	--	--	89,610
South America	3,010	3,070	3,500	20	--	--	--	--	--	9,600
Europe	610	2,060	--	9,100	--	--	330	--	130	12,230
Africa	63,720	15,060	7,530	123,350	2,890	1,170	6,000	40	4,680	224,440
Near East	82,330	22,510	30,970	424,310	29,530	23,880	246,800	11,710	12,100	884,140
Far East	18,590	4,950	--	--	390	--	38,420	190	--	62,540
Oceania	--	--	--	--	--	--	80	110	--	190
Centrally planned economy countries of Europe [3]	--	5,800	180	24,120	770	--	10,220	--	59,710	[3] 103,050
Total [3]	243,430	85,650	45,530	589,780	33,580	25,940	302,090	12,050	76,620	[3] 1,416,920

r Revised.
[1] Data are based on the general trade system. For details on countries included in each area, see footnotes to table 66.
[2] Revised to none.
[3] As reported in source; totals exceed sums of reported destinations by 2,250,000 tons. Discrepancy is unaccounted for.

Source: United Nations. World Energy Supplies 1972–76, New York. Statistical Papers, ser. J, No. 21, 1978, pp. 68–77.

Table 69.—World trade in petroleum refinery products, by geographical area [1]

(Million metric tons)

Area [2]	Exports		Imports		Bunkers	
	1974 r	1975	1974 r	1975	1974	1975
Market economy countries:						
North America	9.81	9.09	125.91	94.87	r 20.47	19.83
Caribbean America	138.17	100.64	19.87	20.79	r 15.28	13.25
South America	.98	1.31	3.50	3.29	r 2.00	2.07
Europe	99.89	86.87	116.45	116.77	r 48.51	47.49
Africa	6.26	7.54	12.45	10.39	r 7.10	6.57
Near East	41.02	39.15	4.55	6.21	r 27.49	19.37
Far East	23.20	15.39	39.36	32.08	r 37.15	37.03
Oceania	2.53	2.87	7.83	6.97	r 4.74	4.31
Centrally planned economy countries:						
Europe	41.23	42.44	5.93	6.32	3.55	3.87
Asia	.44	.82	4.57	4.53	NA	NA
Total [3]	363.53	306.14	340.42	302.22	r 166.33	153.81

r Revised. NA Not available.

[1] Figures given are for fuel commodities only and exclude lubricants and other refinery products not normally used as energy sources. Apparent discrepancies between export, import, and bunker totals evidently result from quantities of material being en route at yearend, incomplete data, and differing practices from country to country in reporting bunkering materials.

[2] For details on countries included in each area, see footnotes to table 66.

[3] Totals are as reported in source and as such may differ from sums of detail owing to independent rounding.

Source: United Nations. World Energy Supplies 1972–76, New York. Statistical Papers, ser. J, No. 21, 1978, pp. 88–100.

The Mineral Industry of Albania

By Nikita Wells [1]

Albania is the world's third largest producer of chromite, after the Republic of South Africa and the U.S.S.R., accounting for 9.2% of the world's production. Other mineral commodities produced by Albania in 1976 included nickeliferous iron ore, copper ore, blister copper, crude oil, petroleum products, lignite, natural gas, natural asphalt, and cement.

Albania's mineral industry, headed by the Ministry of Heavy Industry and Mining, plays an important role in the industrial sector of the country's economy and provides some raw materials for export, of which only chromite is important by world standards. The domestic supply of raw materials is sufficient for the country's present low level of industrial development, and therefore the requirement for imports of raw materials is low. Albania is presently self-sufficient in all forms of energy and is exporting crude oil and electric energy. Nearly 75% of Albania's electric power requirements are supplied by hydroelectric powerplants.

Albania's centrally planned economy is slowly shifting toward industrial expansion. Construction continued on the steel complex at Elbasan, where Albania's first steel was produced in October 1976. This steel complex is Albania's largest investment project. Other major construction projects included the 1-million-ton-per-year Ballësh petroleum refinery, a ferrochromium plant at Burrel, a copper smelter at Laç, a urea plant at Fieri, a polyvinyl chloride plant at Vlora, and a 500-megawatt hydroelectric powerplant at Fierzë. These major industrial projects were being constructed and developed with help from the People's Republic of China.

The production schedules and targets of Albania's economy are prescribed by 5-year plans. The sixth 5-year plan (1976–80) places particular emphasis on the petroleum industry. Special attention is to be given to exploration for new deposits to increase reserves of oil and gas. Crude oil production in 1980 is to increase 11% over that of 1975, while the output of natural gas is to increase 48%. In the previous 5-year plan (1971–75), crude oil production increased 51% and natural gas 206%. Lignite production is to double during 1976–80, compared with a 48% gain during the 1971–75 plan. The nonfuel mineral industry is also to be rapidly developed during the 1976–80 period. In 1980, production of chromite, nickeliferous iron ore, copper ore (metal content), and cement are to increase 46%, 230%, 57%, and 55%, respectively, over the 1975 levels. The corresponding actual increases from 1970 to 1975 were 67%, 62%, 64%, and 190%.

In 1980, electric energy output is to be increased about 220% over that of 1975. Output of hydroelectricity is to treble when the Fierzë hydroelectric powerplant begins operation. Construction is also to be initiated on the hydroelectric powerplant at Kaman on the Drin River.

Since the recent cooling in foreign relations with its closest ally, the People's Republic of China, Albania has been improving relations with its immediate neighbors (Yugoslavia, Greece, and Italy) and has been expanding trade relations with other countries. Albania is also stressing total self-reliance in the eventuality that a complete break is made with the People's Republic of China.

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[1] Physical scientist, International Data and Analysis.

PRODUCTION

In 1976, only limited information on Albania's mineral production was available. The production data used in this chapter are therefore based on published growth-rate data and production goals set for the current 5-year plan.[2] The latest Albanian statistical handbook was published in 1974 and contained only minimal information on mineral commodities for 1973.[3]

The growth rate of overall industrial production in the current 5-year plan is set at 41% to 44%, a more modest rate of increase than the 52% of the previous plan period.[4]

Actual annual production for 1976 exceeded the planned goals for chromite by 1.8%, nickeliferous iron ore by 0.7%, copper ore by 2.3%, blister copper by 3.4%, and crude oil by 0.8%.

In 1976, the production of chromite increased 6.5% over that of 1975 and that of nickeliferous iron ore increased 16.9%. Cement production increased 23% and lignite production 9%. Production of crude oil, however, declined 17% from that of 1975. In the chemical industry, Albania increased its production of phosphatic and nitrogenous fertilizers, as well as of calcined and caustic soda. In October 1976, Albania initiated indigenous crude steel production.

[2] Zeri i Popullit, Tirana. Nov. 5, 1976, pp. 1–8.

[3] 30 Vjet Shqiperi Socialiste, 1974 (30 Years of Albanian Socialism, 1974), Tirana. 1974.

[4] Joos, G. Mosaic Picture of Albanian Economy. Világgazdaság, Budapest. Oct. 20, 1977, p. 5.

Table 1.—Albania: Production of mineral commodities

Commodity [1] and unit of measure	1974	1975	1976 [p]
METALS			
Chromium, chromite (run-of-mine), gross weight, thousand metric tons	715	779	830
Copper:			
Mine output, metal content [2], metric tons	8,580	9,200	10,400
Smelter output (blister), do	8,580	9,200	10,400
Iron and steel:			
Iron ore, nickeliferous, gross weight, thousand metric tons	403	e 650	760
Semimanufactures (rolled angles, shapes, sections), metric tons	e 38,000	e 38,000	40,000
NONMETALS			
Cement, hydraulic, thousand metric tons	555	650	800
Fertilizer materials, manufactured:			
Nitrogenous, do	e 110	e 210	230
Phosphatic e, do	110	120	130
Salt e, metric tons	50,000	50,000	50,000
Sodium carbonate, calcined, do	e 21,000	e 21,000	NA
MINERAL FUELS AND RELATED MATERIALS			
Coal, lignite e, thousand metric tons	850	894	975
Gas, natural, gross production, million cubic feet	e 7,170	e 10,590	12,370
Petroleum: [3]			
Crude:			
As reported, thousand tons	e 2,200	2,300	1,900
Converted, thousand 42-gallon barrels	e 14,678	r e 15,346	12,677
Refinery products:			
Gasoline, do	808	e 850	NA
Kerosine, do	e 310	e 310	NA
Distillate fuel oil, do	r e 1,343	e 1,492	NA
Residual fuel oil, do	r e 2,198	e 2,331	NA
Lubricants, do	e 70	NA	NA
Other:			
Petroleum jelly and wax, do	NA	NA	NA
Asphalt and bitumen, do	e 6,100	NA	NA
Petroleum coke, do	NA	NA	NA
Unspecified, do	e 1,470	NA	NA
Total, do	r e 12,299	NA	NA

e Estimate. p Preliminary. r Revised. NA Not available.

[1] In addition to the commodities listed, a variety of crude construction materials (common clay, sand and gravel, and stone) is undoubtedly produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2] Smelter output is used as an estimate of mine output inasmuch as there is no evidence of ore and/or concentrate exports.

[3] Petroleum data were converted to barrels from metric tons using the following factors: Crude petroleum—6.672, gasoline—8.50, kerosine—7.75, distillate fuel oil–7.46, residual fuel oil–6.66, lubricants—7.00, petroleum jelly and wax—7.87, asphalt and bitumen—6.06, petroleum coke—5.50, and unspecified—7.00. The tonnage figures for "Unspecified" were derived by subtracting the reported tonnages for individual products from a reported total refinery figure, which may have excluded refinery fuel.

TRADE

In 1976, as in previous years, the major portion of Albania's exports was mineral related. Chromite was the only mineral export of importance by world standards and amounted to about 680,000 tons of both metallurgical (beneficiated) and refractory grade. All of the chromite was exported, the bulk going to the People's Republic of China, Yugoslavia, Italy, Poland, and Japan. Albanian exports of crude oil in 1975 were 450,000 tons, and those of asphaltic flux (natural bitumen) were about 1.0 million tons. Other Albanian exports were nickeliferous iron ore, blister and electrolytic copper, and copper wire.

Albania imports mainly capital goods. The main mineral-related imports are iron and steel semimanufactures, coke, phosphate rock, and potash. The People's Republic of China is Albania's principal trade partner, with an estimated $230 million or 70% of the value of all Albanian trade in was Yugoslavia, followed by Italy, Poland, 1975. The second largest trading partner West Germany, Austria, Romania, and Greece.

Albania signed a trade agreement with Poland at yearend whereby Poland will export coke, metallurgical products, and chemicals to Albania. Albania, in return, is to export chromium ore, petroleum asphalt, copper wire, and cables to Poland.[5] Albania will import engineering products, chemicals, and rolling stock from Czechoslovakia which will in turn receive nickeliferous iron ore and asphalt. A trade agreement between Romania and Albania was also signed in 1976 which stated that Romania will supply Albania with petroleum products, chemicals, and mechanical engineering goods in return for chromite, nickeliferous iron ore, and copper wire.[6]

[5] Polish Foreign Trade, Warsaw. V. 181, No. 6, June 1977.
[6] Romanian Foreign Trade, Bucharest. No. 3, 1976, p. 13.

Table 2.—Albania: Apparent exports of selected mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Chromite ---thousand tons--	r 570	730	People's Republic of China e 305; Yugoslavia 103; Japan 58; Poland 56; United States 41; Italy 35; Sweden 27.
Copper metal:			
Unwrought	1,256	950	All to Italy.
Semimanufactures	500	100	All to Yugoslavia.
Iron and steel scrap	3,327	542	All to Italy.
Silver, waste and sweepings value, thousands--	$177	$214	Do.
NONMETALS			
Cement	11,608	26,531	All to Yugoslavia.
Clays and clay products, nonrefractory --	28,122	16,431	Do.
Sodium and potassium compounds: Soda ash	2,916	1,166	Greece 966; Yugoslavia 200.
Stone, dimension, calcareous	767	1,482	All to Italy.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,094	2,029	All to Yugoslavia.
Coke	NA	527	All to Greece.
Petroleum:			
Crude --thousand 42-gallon barrels--	579	138	Italy 105; Hungary 33.
Refinery products:			
Gasoline ---do---	86	87	All to Italy.
Distillate fuel oil ---do---	37	36	Do.
Bitumen ---do---	1,499	1,566	Italy 600; Hungary 410; Greece 300; Yugoslavia 246.
Unspecified ---do---	31	931	All to Poland.

e Estimate. r Revised. NA Not available.
[1] Compiled from data of Austria, Czechoslovakia, France, West Germany, Greece, Hungary, Italy, Japan, Norway, Poland, Spain, Sweden, the United States, and Yugoslavia.
Source: For Czechoslovakia, Hungary, and Poland—official trade statistics of the respective country; for all other countries—Statistical Office of the United Nations. 1975 Supplement to the World Trade Annual. Walker and Co., New York, v. 1 (Eastern Europe and the U.S.S.R.), 1978, pp. 102–109.

Table 3.—Albania: Imports of selected mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum metal including alloys, all forms	1,513	1,166	Hungary 835; West Germany 173; Yugoslavia 128.
Copper metal including alloys, all forms	NA	133	All from West Germany.
Iron and steel metal:			
Pig iron, including cast iron and ferroalloys	2,657	3,812	Poland 3,757; Yugoslavia 55.
Semimanufactures:			
Bars, rods, angles, shapes, sections	20,400	28,208	Poland 10,753; Belgium-Luxembourg 4,726; Greece 4,692; Italy 2,991.
Universals, plates, sheets	65,690	23,180	Poland 12,803; Hungary 2,955; Greece 2,894.
Wire	120	191	West Germany 120; Italy 71.
Tubes, pipes, fittings	4,590	9,948	West Germany 5,364; Italy 2,715.
Hoop and strip	1,210	684	Greece 300; France 250.
Rails and accessories	1,320	1,291	Italy 700; Austria 500.
Lead oxides	103	50	All from Italy.
Nickel metal including alloys, all forms	NA	3	All from West Germany.
Titanium oxides	91	105	All from Yugoslavia.
Zinc:			
Oxide and peroxide	25	37	Do.
Metal including alloys, all forms	140	168	West Germany 104; Yugoslavia 64.
NONMETALS			
Asbestos, crude	745	846	All from Yugoslavia.
Cement, hydraulic	NA	1,292	All from Greece.
Clays and clay products, refractory	216	2,587	Poland 1,412; Yugoslavia 949; Italy 160.
Fertilizer materials, manufactured, potassic	NA	5,795	West Germany 4,500; Italy 1,295.
Sodium and potassium compounds:			
Caustic soda	524	176	All from Yugoslavia.
Sulfur:			
Elemental	676	1,132	All from Greece.
Sulfuric acid	1,565	4,268	All from Yugoslavia.
MINERAL FUELS AND RELATED MATERIALS			
Coal tar	NA	200	All from Poland.
Coke thousand tons	11	15	All from Yugoslavia.
Petroleum refinery products:			
Distillate and residual fuel oils thousand 42-gallon barrels	141	4	All from Italy.
Lubricants do	4	100	Do.

NA Not available.

[1] Compiled from data of Austria, Belgium-Luxembourg, France, West Germany, Greece, Hungary, Italy, Japan, Poland, and Yugloslavia.

Source: For Hungary and Poland—official trade statistics of the respective country; for all other countries—Statistical Office of the United Nations. 1975 Supplement to the World Trade Annual. Walker and Co., New York, v. 1 (Eastern Europe and the U.S.S.R.), 1978, pp. 99–101.

COMMODITY REVIEW

METALS

Chromite.—In 1976, Albania produced 830,000 tons of chromite (run-of-mine), demonstrating an increase of 6.5% over the 1975 output. Albania remained the world's third largest producer of chromite with 9.2% of total production, following the Republic of South Africa and the U.S.S.R. According to the sixth 5-year plan, chromite production is to increase more than 46% over that of 1975 by 1980. Albania exported all of its chromite output in 1975.

Albania's chromite mining is concentrated in the Bulgiza area, northeast of Tirana, with deposits at Batra and Thekna; in Tropojë and Kukës in the north (Karn, Ragarn, and Kalimash); and in the south, near the shore of Lake Ohrid in the Shebenik-Pogradec area.[7] Presently, Albania has about seven chromite mines, of which the Todo Manco mine is the largest. It is equipped with a 200,000-ton-per-year ore beneficiation plant. The average grade of chromite that was exported increased from 22.8% Cr_2O_3 content in 1960 to 36.5% in 1970 and to approximately 38.0% in 1975. In 1973, the average Albanian chromium ore contained 37.5% Cr_2O_3, 13% FeO, and 22% Al_2O_3.

Construction is presumed to have continued during 1976 on the ferrochromium plant at Burrel, located in the Mat District. This plant is to supply the Elbasan metal-

[7] Pumo, E. Mineral Deposits of Albania. L'Industria Mineraria, Rome. July/August 1977, pp. 262–271.

lurgical complex and will enable Albania to reduce chromite to metal within the country for the first time. The plant is being built with help from the People's Republic of China.

Copper.—Albania's blister copper production increased 13% in 1976, reaching an estimated 10,400 tons, 3.4% over the planned figure. In 1980, blister copper production is to increase 57% over that of 1975 according to the sixth 5-year plan. About 60% of the blister copper was to have been processed into wire in 1975, while the rest was to be used as refined metal, bronze, or brass. The Mirditë District produces about 45% of Albania's blister copper, 50% of the copper ore, and all of the electrolytic copper. The copper deposits are located in the north in the Mirditë, Kukës, Pukë, and Shkodër Districts, where reserves are estimated at 50 million tons of low-grade ore.

During 1976, Albania continued construction of the smelter located at Laç in the Kruja District, north of Tirana. Albania's other two copper-smelting plants are located in the Mirditë and Kukës Districts.

Iron Ore.—Production of nickeliferous iron ore in 1976 reached an estimated 760,000 tons, showing an increase of 16.9% over that of 1975, slightly more than the planned increase of 16%. By 1980, the production of nickeliferous iron ore is to increase as much as 230% over that of 1975. Until 1975, all of the ore had been exported. After that time, part of the ore was to be used by the Elbasan steel plant which was to be operational by then, but no definite data have as yet been published on this development.

Most of Albania's nickeliferous iron ore mines are surface-mining operations. The most important mines are located near Lake Ohrid at Pishkash and Prrenjas in the Pogradec and Librazhd Districts. Three new mines were reported to be under development at Prrenjas, Guri-i-Kug, and Cervenaka and were to be commissioned shortly. A railroad was completed connecting Prrenjas to the Elbasan steel complex, and a second railroad line is under construction, linking Guri-i-Kug to Prrenjas. Albanian nickeliferous iron ore contains, on the average, 51% iron, 1% nickel, and 0.06% cobalt. Other components amount to 3.6% Cr_2O_3, 5.1% SiO_2, 5.5% Al_2O_3, and 5% to 10% H_2O.[8] In the future, Albania plans to recover the nickel and cobalt from the ore.

Iron and Steel.—Albania's largest investment project during the 1976–80 period is the construction of a steel plant at Elbasan (the Elbasan metallurgical complex) which began in 1971. The commissioning of the plant will represent the advent of an indigenous iron and steel industry in Albania. According to incomplete reports, the first steel was produced in October 1976, although the blast furnace had been operating since 1975. The capacity of the steel plant is to reach 800,000 tons per year by 1980 and is to include ingots, bars, wire, sheet, and other products. It is being built with the assistance of the People's Republic of China, which is also providing the bulk of the equipment. Some machinery, however, has been purchased from West Germany.[9]

NONMETALS

Little information on production, trade, and development of Albanian nonmetallic minerals was published in 1976. Production of cement and mineral fertilizers showed marked improvement in 1976. Other nonmetals produced in 1976 included soda ash, caustic soda, asbestos, kaolin, gypsum, lime, limestone, salt, silica, sulfur, sulfuric acid, and volcanic glass.

Cement.—Cement production in 1976 reached 800,000 tons, an increase of 23% over that of 1975. By 1980 cement production is to increase 55% over that of 1975. Albania's two cement plants are located at Fusë-Krujë and Elbasan.

Fertilizer Materials.—In 1976, production of nitrogenous fertilizers increased 10% over that of 1975, reaching an estimated 230,000 tons.

The 36,000-ton-per-year (nitrogen content) urea plant at Fieri was completed during 1976.[10] This plant is to double Albania's nitrogenous fertilizer production upon full operation. The Fieri plant is Albania's only nitrogenous fertilizer plant and already has facilities to manufacture ammonia and ammonium nitrate.

In 1976, Albania imported 62,000 tons of phosphate rock from Morocco and 10,000

[8] Pages 267–268 of work cited in footnote 7.
[9] Világgazdaság, Budapest. Aug. 18, 1976, p. 2.
[10] Nitrogen, London, No. 103, September/October 1976, p. 13.

tons from Algeria. During the same year, imports of potash totaled 5,000 tons.

MINERAL FUELS

Albania was self-sufficient in all forms of energy in 1976 and continued to export surplus crude oil and electric energy. Nearly 75% of Albania's electric power requirements were supplied by hydroelectric powerplants.

Production of primary energy in Albania in 1976 was slightly lower (8.4%) than in the previous year, reaching 4.14 million tons of standard coal equivalent (SCE). Primary energy exports totaled 1.36 million tons SCE, mostly in the form of petroleum, and imports totaled 20,000 tons SCE, all in the form of coal and coke. Albania's primary energy consumption in 1976 showed a 12% decline, reaching 2.8 million tons SCE. Petroleum accounted for 52.9% of total Albanian energy consumption in 1976, coal and coke 25.0%, natural gas 16.8%, and hydroelectricity 5.3%. Total primary energy balances for Albania in 1975 and 1976 are shown in table 4.

Coal.—Albania has no bituminous coal. Indigenous lignite contributed approximately 16% to total primary energy production in 1976. Lignite production, at an estimated 975,000 tons, was 9% greater than in 1975 and is planned to be double the 1975 level by 1980. Most of the new production is to come from expanded mines.

In 1975, production started at the new mine at Valias, near Tirana, where a coal beneficiation plant was being built with help from the People's Republic of China. The capacity of the Memaliaj mine was expanded, and output in 1976 was to have increased 20,000 tons. Two additional mines have recently gone into operation at Mushqeta and Mëzez. By 1980, Albania plans to beneficiate 60% of the lignite produced.

Albanian lignites and subbituminous coals have a calorific value of about 4,900 kilocalories per kilogram (8,800 Btu per pound). The largest deposits are located near Korcë, at Memaliaj; near Tepelenë; and in a triangular area bounded by Tirana, Elbasan, and Lushnjë.

Petroleum.—Albania's crude oil production in 1976 declined sharply (17%) totaling 1,900,000 tons.[11] The present 5-year plan provides for a relatively small increase of 11% in crude oil production for the 1976–80 period.

Albania's second most significant investment after the Elbasan steel complex is the oil refinery under construction at Ballësh near Valona. Supposedly, completion of the 1-million-ton-annual-capacity refinery was scheduled for late 1975. With the new refinery in full operation, Albania's petroleum products exports should increase while crude oil exports decrease. Greece and Romania are the principal markets for exported Albanian crude petroleum.

Albania's crude oil reserves are concentrated in the areas west of Stalin within a

[11] Nafta, Krakow. V. 23, No. 6, June 1977, p. 213.

Table 4.—Albania: Total primary energy balances for 1975 and 1976 [1]

(Million tons of standard coal equivalent [2])

Year	Total primary energy	Coal (lignite, anthracite, bituminous) and coke	Crude oil and petroleum products	Natural and associated gas	Hydroelectric power, etc.
1975:					
Production	4.52	0.63	3.31	0.40	0.18
Imports	.02	.02	--	--	--
Exports	1.36	--	1.31	--	.05
Apparent consumption	3.18	.65	2.00	.40	.13
1976:					
Production	4.14	.68	2.79	.47	.20
Imports	.02	.02	--	--	--
Exports	1.36	--	1.31	--	.05
Apparent consumption	2.80	.70	1.48	.47	.15

[1] Data obtained from various Albanian sources and estimates.

[2] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories. Conversion factors used are: Lignite, 0.7; crude oil, 1.47; natural gas, 1.33 (per thousand cubic meters); and hydroelectric power, 0.125 (per thousand kilowatt-hours); these factors were obtained from: United Nations. World Energy Supplies. Statistical Papers, ser. J, No. 18, 1975.

triangle formed by Vlorë, Berate, and Durres. The crude oil produced has an average specific gravity of 0.98; according to past reports, it yielded 13% gasoline, 8% kerosine, 18% gas oil, 40% asphalt, and 18% residuals, and contained 3% sulfur.

Albania's crude oil exports were sent abroad from the seaport of Vlorë, which is connected to the oilfields and refineries by a pipeline system. Total refining capacity, estimated at 2 million tons per year (excluding the new refinery at Ballësh, last reported to be under construction), was distributed as follows: Fieri, 1.0 million tons; Stalin, 0.5 million tons; and Cerrik, 9.5 million tons.

Natural Gas.—Albania's natural gas production for 1976 was estimated at 350 million cubic meters. By 1980, natural gas production is to increase 48% over that of 1975.

The increase in Albanian natural gas production in 1975 and 1976 was ascribed to recent gas finds at Diviakë and Budulinë in the Lushnjë District.

Total gas resource estimates have not been published by official sources but are thought to be about 8 trillion cubic feet.

The Mineral Industry of Algeria

By David E. Morse [1]

The petroleum and natural gas industry, the most important sector of the country's economy, dominated the mineral industry of Algeria in 1976. Algeria's production of metallic minerals remained modest by world standards. Although Algeria produced iron, copper, mercury, lead and zinc ores and concentrates, and other metals, only iron and mercury were significant. Algeria was one of Africa's largest producers of barite, cement, and gypsum, and a minor producer of phosphate rock. Exploration, production, processing, and marketing of mineral commodities was carried out by the autonomous State-owned Société Nationale de Recherches et d'Exploitations Minières (SONAREM). Natural gas and petroleum activities were dominated by the State-owned Société National pour la Recherche, la Production, le Transport, la Transformation et la Commercialisation des Hydrocarbures (SONATRACH).

Algeria continued its strong economic growth in 1976, and the gross domestic product (GDP) increased 23.5% to $15,300 million[2] after an increase of nearly 8% in 1975. Petroleum and natural gas contributed over 30% to the GDP, and provided nearly 60% of the revenue for the Government's 1976 balanced budget. The 1976 inflation rate was put at 12% by the Finance Minister.

The Government continued its deep and ambitious commitment to industrialization under the second development plan (1974–77). SONATRACH was investing in new petroleum refineries, liquefied natural gas (LNG) plants, gas and oil pipelines, and oil production wells to increase exports of hydrocarbons. Significant investments in petrochemical, methanol, plastic, resin, and chlorine plants were underway or planned by SONATRACH. Large investments had been made or planned for plants producing fertilizer materials using natural gas feedstocks and domestic phosphate rock. In the manufacturing sector the second development plan called for heavy investments in the steel, nonferrous metals, and construction materials industries. The Government also invested large sums for education and training to combat the shortage of skilled and semiskilled manpower.

After several years of construction, a new port at Ghazaouet in northwest Algeria was readied for operation. The port could handle 1 million tons per year of bulk cargo and would serve the regions along the Moroccan border from Tlemcen to Becar.

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Algerian dinars (DA) to U.S. dollars at the rate of DA4.1638=US$1.00.

PRODUCTION

There were no significant changes in Algeria's production of metals in 1976. Lead and zinc, mercury, and copper remained stagnant while iron ore output continued to decline. Crude oil production increased 9.5% compared with 1975 output and averaged 1.07 million barrels per day. Crude oil condensate production exceeded 18 million barrels, and liquefied petroleum gas output increased 12%. The gross production of natural gas remained fairly stable, although usage increased because of improvements to processing facilities.

Table 1.—Algeria: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
METALS				
Antimony concentrate:				
Gross weight [e]		150	150	--
Metal content [e]		60	[r] 60	--
Copper concentrate:				
Gross weight		1,638	1,609	[e] 1,600
Metal content		377	370	[e] 370
Iron and steel:				
Iron ore, gross weight	thousand tons	[r] 3,797	3,188	2,800
Metal:				
Pig iron	do	276	399	[e] 460
Crude steel	do	250	301	[e] 350
Semimanufactures	do	165	211	NA
Lead concentrate:				
Gross weight		4,576	4,453	[e] 4,500
Metal content		[r] 3,100	2,900	3,600
Mercury	76-pound flasks	14,000	28,000	31,000
Silver [e]	thousand troy ounces	[r] 130	[r] 120	150
Zinc:				
Concentrate:				
Gross weight		19,167	23,816	[e] 22,000
Metal content		11,000	15,000	14,000
Smelter		8,000	20,000	24,000
NONMETALS				
Barite, crude		[r] 52,950	67,600	75,000
Cement, hydraulic	thousand tons	941	948	1,400
Clays:				
Fuller's earth		22,000	[e] 22,000	[e] 22,000
Kaolin		9,000	11,000	8,000
Bentonite [e]		[r] 30,000	[r] 35,000	39,000
Diatomite		[r] 3,400	10,000	[e] 15,000
Fertilizer materials, phosphate rock	thousand tons	802	669	820
Gypsum and plasters [e] [2]	do	[r] 175	[r] 175	175
Lime, hydraulic	do	12	11	[e] 11
Salt	do	140	125	136
Sodium compounds, caustic soda		3,000	NA	NA
Strontium minerals, celestite, gross weight		200	--	--
Sulfur, elemental		15,000	10,000	9,876
MINERAL FUELS AND RELATED MATERIALS				
Coal	thousand tons	[r] 10	8	3
Gas, natural:				
Gross production	million cubic feet	700,251	739,874	[e] 750,000
Marketed (including liquefied)	do	198,502	336,628	370,802
Natural gas plant liquids (condensate) [e]	thousand 42-gallon barrels	[r] 12,100	17,900	18,000
Petroleum:				
Crude	do	368,139	350,753	383,816
Refinery products:				
Gasoline	do	6,096	6,771	6,893
Jet fuel and kerosine	do	2,920	3,523	3,144
Distillate fuel oil	do	13,724	11,647	10,580
Residual fuel oil	do	8,906	9,835	9,222
Lubricants	do	--	14	128
Other	do	1,168	6,955	6,522
Refinery fuel and losses	do	3,759	976	894
Total	do	36,573	39,721	37,383

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, secondary aluminum, secondary lead, and copper may be produced in small quantities, and additional crude construction materials (crude clays and stone) presumably are produced for local consumption, but output is unreported and available information is inadequate to make reliable estimates of output levels.

[2] Includes plasters as follows in tons: 1974—48,408; 1975—49,441; 1976—[e] 50,000.

TRADE

In 1976, Algeria exported large quantities of petroleum and natural gas, mainly to Europe and the United States. The United States imported 149.2 million barrels of crude oil from Algeria, an increase of 64.4 million barrels compared with the 1975 level. The value of exported crude oil in 1976 was about $4,120 million, and petroleum exports represented 86% of Algeria's total exports during the year. Of the crude oil exported during the year, 50% went to Europe, 40% to North America, and 10% to Asia and other areas. LNG exports were about 4,950 million cubic meters (8.5 million barrels) with over 90% going to Europe and less than 5% to the United States. LNG exports were valued at approximately $80 million.

Table 2.—Algeria: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	412	271	France 176; Belgium-Luxembourg 95.
Copper:			
Ore and concentrate	820	1,690	Czechoslovakia 920; Bulgaria 770.
Metal including alloys, all forms	r 1,472	1,713	France 1,428.
Iron and steel:			
Ore and concentrate ----thousand tons	2,913	1,386	Romania 689; Belgium-Luxembourg 294; Czechoslovakia 216.
Metal:			
Scrap	51,601	70,801	Spain 43,071; Italy 24,846.
Pig iron, ferroalloys, and similar materials	r 115,974	194,331	Italy 76,221; People's Republic of China 40,142; U.S.S.R. 15,712.
Semimanufactures	r 21,509	47,193	Italy 38,602.
Lead:			
Ore and concentrate	77,183	4,695	Tunisia 4,057; Switzerland 638.
Metal including alloys, scrap	1,102	--	
Mercury ----76-pound flasks	r 29,813	8,605	United States 5,802; West Germany 1,551.
Nickel:			
Ore and concentrate	12,400	--	
Metal including alloys, all forms	22	35	All to Belgium-Luxembourg.
Thorium, ore and concentrate	724	--	
Titanium, ore and concentrate	1,253	--	
Zinc:			
Ore and concentrate	3,556	--	
Metal including alloys	481	7,207	Egypt 4,000; Greece 1,398.
Other:			
Ore and concentrate	--	24,978	All to United Kingdom.
Metal including alloys, all forms	--	16	Netherlands 10; Belgium-Luxembourg 6.
NONMETALS			
Abrasives, grinding and polishing wheels and stones ----kilograms	600	(1)	All to France.
Bromine	131	161	All to Tunisia.
Cement, hydraulic	2,001	4,800	All to Greece.
Clays and clay products (including all nonrefractory brick):			
Crude clays, n.e.s.:			
Kaolin and bentonite	4,233	800	Spain 400; Tunisia 220; United Kingdom 140.
Other	r 4,655	80	All to France.
Products, nonrefractory	(1)	(1)	Do.
Diatomite and other infusorial earth	5,380	4,146	France 1,265; Morocco 1,200; United Kingdom 977.
Fertilizer materials:			
Crude phosphatic	353,784	213,365	France 64,975; Czechoslovakia 60,400; Hungary 44,736.
Manufactured:			
Phosphatic	29,603	--	
Other including mixed	34,027	--	
Ammonia	4,965	5,453	All to Greece.
Fluorine	77	--	
Pyrite, unroasted	74,109	236,012	Romania 158,294; Belgium-Luxembourg 24,218.

See footnotes at end of table.

Table 2.—Algeria: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Salt	r 47,486	10,500	France 4,000; Ivory Coast 2,500; Dahomey 1,900.
Stone, dimension, marble	52	--	
Sulfur, sulfuric acid	3,006	5,344	All to Tunisia.
Other nonmetals, n.e.s., crude	--	1,000	All to U.S.S.R.
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural, liquefied ---million cubic feet	r 120,211	105,820	France 52,797; United Kingdom 36,943; Spain 5,972.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	279,491	294,463	United States 84,779; West Germany 61,918; France 45,331.
Refinery products:			
Gasoline ---do---	7,623	6,720	Netherlands 2,985; United States 996.
Jet fuel and kerosine ---do---	1,097	1,129	Zaire 438; Dahomey 263; Congo 223.
Distillate fuel oil ---do---	3,599	2,816	Netherlands 635; Zaire 528; Dahomey 459.
Residual fuel oil ---do---	6,730	7,406	United States 6,897.
Lubricants ---do---	88	(1)	Mainly to France.
Other ---do---	360	(1)	All to Finland.
Total ---do---	19,497	18,071	

r Revised.
1 Less than ½ unit.

Table 3.—Algeria: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Oxide and hydroxide	328	405	Italy 300; France 100.
Metal including alloys, all forms	7,754	75,872	France 69,141.
Antimony metal including alloys, all forms	77	53	Belgium-Luxembourg 23; West Germany 15.
Arsenic:			
Natural sulfides	--	5	All from Turkey.
Oxide and acid	30	45	Mainly from France.
Chromium oxide and hydroxide	20	11	France 7; West Germany 3.
Cobalt oxide and hydroxide	(1)	(1)	All from West Germany.
Copper:			
Copper sulfate	229	138	Belgium-Luxembourg 127.
Metal including alloys, all forms	7,184	15,490	Spain 5,229; Sweden 3,999; Italy 2,575.
Iron and steel, metal:			
Scrap	84	52	West Germany 35; France 10.
Pig iron, ferroalloys and similar materials	3,499	12,739	West Germany 7,284; France 1,983; Japan 1,379.
Steel, primary forms	r 121,340	60,244	Japan 30,431; France 10,488; Belgium-Luxembourg 8,179.
Semimanufactures	402,097	303,585	France 57,617; Italy 55,531; West Germany 53,075.
Lead:			
Ore and concentrate	5	--	
Oxides	r 1,722	836	France 536; West Germany 150.
Metal including alloys, all forms	5,594	9,647	Tunisia 3,461; France 2,737; West Germany 2,691.
Magnesium metal including alloys, all forms	3	14	Italy 7; Japan 6.
Manganese oxide	465	1,216	West Germany 517; Greece 498.
Mercury ---76-pound flasks---	35	1,267	Japan 841; France 414.
Nickel:			
Ore and concentrate	(1)	--	
Metal including alloys, all forms	48	21	France 11; Italy 5.
Platinum-group metals and silver including alloys:			
Platinum group ---troy ounces---	1,672	1,190	Belgium-Luxembourg 836.
Silver ---do---	35,559	50,058	France 41,024.

See footnotes at end of table.

Table 3.—Algeria: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Rare-earth metals:			
Oxides	5	1	All from Italy.
Metal including alloys	(1)	13	Belgium-Luxembourg 8; West Germany 4.
Tin metal including alloys, all forms	445	145	Switzerland 50; France 34; Malaysia 31.
Titanium:			
Ore and concentrate	111	322	Australia 302.
Oxide	2,945	479	West Germany 374; France 36.
Tungsten metal including alloys, all forms	(1)	(1)	Mainly from Italy and United Kingdom.
Zinc:			
Ore and concentrate	7,613	--	
Oxide	751	251	France 213; West Germany 27.
Metal including alloys, all forms	4,116	3,610	France 2,550; Bulgaria 500.
Zirconium ore and concentrate	1	15	Mainly from Italy.
Other:			
Ore and concentrate	(1)	61	Mainly from France.
Oxides, hydroxides and peroxides, n.e.s	r 734	800	France 742.
Metals including alloys, all forms:			
Metalloids	r 4	328	United Kingdom 304.
Pyrophoric alloys	(1)	(1)	Mainly from United States.
Base metals including alloys	4	33	Italy 22; France 8.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	49,117	102,191	Greece 56,425; Italy 45,591.
Grinding and polishing wheels and stones	375	552	France 211; Italy 152.
Dust and powder of precious and semiprecious stones	(1)	--	
Asbestos	3,872	4,582	U.S.S.R. 4,096.
Barite and witherite	10	27,495	Italy 18,164; Tunisia 6,321.
Boron materials:			
Crude natural borates	2	6	Mainly from France.
Oxide and acid	24	24	United States 11; France 9.
Bromine	1	11	West Germany 6; France 4.
Cement ----thousand tons	1,814	1,981	Spain 1,073; Greece 374; France 318.
Chalk	15,843	20,949	France 20,708.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Kaolin	6,143	6,281	United Kingdom 4,222; Spain 1,250; France 755.
Other	4,117	5,206	France 2,571; Morocco 793; Spain 700.
Products:			
Refractory (including nonclay brick)	18,066	30,391	West Germany 9,994; France 6,008; United Kingdom 4,616.
Nonrefractory	3,418	7,764	Spain 5,689.
Cryolite and chiolite	315	3	All from West Germany.
Diamond, industrial ----thousand carats	115	2,380	West Germany 1,880; France 500.
Diatomite and other infusorial earth	2	10	United States 6; France 4.
Feldspar	1,344	951	Italy 800; France 151.
Fertilizer materials:			
Crude and manufactured:			
Nitrogenous	110,701	152,719	Romania 116,606; Bulgaria 30,182.
Phosphatic	10,035	20,100	Tunisia 9,900; Romania 6,500.
Potassic	70,783	68,608	Spain 36,596; Italy 32,010.
Other including mixed	r (1)	2	Mainly from France.
Ammonia	57	38,572	United States 17,253; Kuwait 10,003; Belgium-Luxembourg 3,998.
Fluorspar	90	489	All from France.
Graphite, natural	57	98	West Germany 87; France 11.
Gypsum and plaster	r 1,335	5,881	Italy 2,180; Spain 1,710; France 1,189.
Iodine	(1)	1	All from France.
Lime	3,359	4,026	France 2,312; Tunisia 780.
Magnesite	1,561	216	Austria 200.
Mica, crude, including splittings and waste	297	15	All from France.
Pigments, mineral:			
Natural crude	88	170	France 120; West Germany 41.
Iron oxides, processed	491	852	West Germany 652; France 161.
Salt and brine	31	28	West Germany 26.
Sodium and potassium compounds, n.e.s	9,615	11,667	Italy 9,050; France 1,271.

See footnotes at end of table.

Table 3.—Algeria: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	3	10	All from France.
Worked	17	69	France 48.
Dolomite, chiefly refractory grade	187	2,207	Spain 1,000; France 567; West Germany 349.
Gravel and crushed rock	33,702	6,585	Italy 6,520.
Quartz and quartzite	438	695	Belgium-Luxembourg 641; France 52.
Sand, excluding metal bearing	447	2,089	Belgium-Luxembourg 1,300; Spain 596; France 132.
Sulfur:			
Elemental:			
Other than colloidal	83,172	82,420	Poland 61,229; Canada 11,191.
Colloidal	r 2,048	975	All from France.
Sulfur dioxide	359	67	West Germany 62.
Sulfuric acid	27,153	19,517	West Germany 8,301; Italy 7,233; Switzerland 3,931.
Talc, steatite, soapstone, pyrophyllite	2,171	3,425	France 3,275.
Other nonmetals, n.e.s.:			
Crude:			
Vermiculite, perlite, chlorite	13	704	Greece 470; France 226.
Other	522	158	West Germany 56; Ethiopia 50; Switzerland 47.
Oxides and hydroxides of magnesium, strontium, barium	6	7	West Germany 3; United States 2.
Fluorine, elemental	530	90	Mainly from Spain.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	32	10	France 3; United Kingdom 3; United States 3.
Carbon black	r 1,181	2,864	United Kingdom 820; France 789; Italy 545.
Coal, all grades, including briquets	47,390	36,493	U.S.S.R. 28,815; Romania 6,793.
Coke and semicoke	198,088	236,142	Italy 101,922; U.S.S.R. 91,217.
Hydrogen, helium, rare gases	r 48	121	France 116.
Peat	17	32	West Germany 18; Netherlands 14.
Petroleum:			
Crude ——thousand 42-gallon barrels	(1)	(1)	All from West Germany.
Refinery products:			
Gasoline ——do——	159	593	Italy 391; France 156.
Jet fuel and kerosine ——do——	1	13	Spain 6; Italy 4.
Distillate fuel oil ——do——	75	328	Italy 251; France 76.
Residual fuel oil ——do——	130	500	Italy 394; France 106.
Lubricants ——do——	394	523	United Kingdom 507.
Other:			
Liquefied petroleum gas ——do——	323	272	Venezuela 195; France 62.
White spirits ——do——	19	26	Netherlands 14; France 11.
Petroleum jelly and wax ——do——	62	57	West Germany 47.
Asphalt and bitumen ——do——	403	394	Spain 209; France 160.
Petroleum coke and flux ——do——	4	2	All from France.
Unspecified ——do——	735	11	United Kingdom 8.
Total ——do——	2,305	2,719	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r 10	6	All from United States.

r Revised.
1 Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—Algeria and the Soviet Union signed a contract in April for the construction of an electrolytic aluminum smelter at M'sala in the Sétif District of north-central Algeria. The Soviet Union would construct the 140,000-ton-per-year smelter with payment from Algeria in the form of metallic aluminum. Included in the project was a 600-megawatt thermal powerplant to furnish the electricity requirements of the smelter. The powerplant was to run on domestic natural gas, and the raw material for the aluminum plant was to come from Jamaica and Guinea. Under the terms of the contract the port of Béjaïa would be developed, and M'sala would be connected to the national rail network.

Iron Ore.—SONAREM planned the mine development and rail link to the remote Gara Djebilet iron deposits in southwest Algeria. The Gara Djebilet deposits were estimated to contain over 1,000 million tons of hematitic ore averaging 58% iron. The Ouenza open pit mine near Annaba continued to be Algeria's largest producer of iron ore. Expansion was underway at Ouenza in 1976 to increase its output to 5 million tons per year.

Iron and Steel.—Algeria's industrial expansion under the second development plan included large expenditures for the steel industry. Expansion at the El Hadjar steel complex near Annaba was to include a third blast furnace with a 2,000-cubic-meter volume rated at 1.3 million tons per year, new hot-rolling machinery to increase capacity to 1.3 million tons per year, cold-rolling machinery to increase capacity to 700,000 tons per year, and a new bank of coke ovens. When the expansion is completed, Algeria will be a net importer of iron ore instead of an exporter.

Lead and Zinc.—The El Abed mine in western Algeria remained the country's largest producer of lead and zinc ore and concentrates in 1976. The expansion and development work begun in 1973 at El Abed was nearly completed during the year. The mine's output of zinc concentrate was processed at the nearby 40,000-ton-per-year electrolytic zinc plant in Ghazaouet. Development was underway to expand the output of the Kherzet Youssef mine south of Sétif. Beginning in 1978, about 20,000 tons per year of zinc concentrate is to be shipped from Kherzet Youssef to the zinc plant at Ghazaouet.

Mercury.—Algeria and five other countries (Italy, Spain, Yugoslavia, Turkey, and Peru) belong to the International Association of Mercury Producers. The organization was formed in 1975 in response to depressed world mercury prices. The mercury plant at Annaba, which came onstream in late 1974, operated nearly at capacity during 1976. Production figures for 1974 and 1975 increased to 14,000 and 28,000 flasks, respectively. The total Algerian output for 1976 was 31,000 flasks. Over 95% of the mercury produced in Algeria in 1976 was exported.

Uranium.—Development of the uranium deposits in the Hoggar Plateau of southern Algeria was planned to begin in 1980. SONAREM signed a contract with a French consortium to study the various technical solutions that could be used to exploit the deposits and determine the best method to be used. Exploratory drilling indicated that 12,000 tons of uranium and 30,000 tons of tungsten are contained in the Hoggar deposits.

NONMETALS

Cement.—Société Nationale des Matériaux de Construction (SNMC) operated cement plants at Point Pescade, Meftah, Zahna, and El Hadjar with an installed capacity of about 2.5 million tons per year during 1976. SNMC signed a contract with an unnamed Japanese firm to construct a second 1-million-ton-per-year cement plant at El Asnam, near Algiers. The first 1-million-ton cement plant at El Asnam was under construction in 1976. Other contracts in effect during 1976 called for construction of 1-million-ton-per-year cement plants at Ain el Kebira near Sétif, at Zahana near Oran, at Beni Saf near Oran, and at Hamma Bouziene near Constantine, as well as a joint Algerian-Tunisian plant at Djebel Boulahneche in western Tunisia. A 500,000-ton-per-year plant at Saida near Mascara was under construction and was due onstream in mid-1977. The total addition to Algeria's cement capacity was to be 7.5 million tons per year, and all plants were to be in operation by 1980.

Fertilizer Materials.—*Nitrogen.*—SONATRACH planned to use Hassi R'Mel natural gas as feedstock for new 330,000-ton-per-year ammonia plants at Arzew and Annaba. At Arzew, the expansion to bring the ammonium nitrate plant to 330,000 tons per year was due onstream in late 1977, the 240,000-ton-per-year expansion to the nitric acid plant was underway, and a 330,000-ton-per-year urea plant was planned. A 165,000-ton-per-year ammonium nitrate plant and a 195,000-ton-per-year nitric acid plant were due onstream at Annaba in 1978. A 528,000-ton-per-year sulfuric acid plant was planned for the Annaba area and was to be onstream by 1980.

Phosphorus.—SONAREM planned to increase phosphate rock output to 6 million tons per year of crude ore by 1980 from the Djebel Onk and Djebel Koiuf mines near Bir-El-Ater, close to the Tunisian border. A processing plant to increase refined phosphate output by 900,000 tons per year at

Djebel Onk was under construction and was to be onstream in 1979. A phosphoric acid plant (165,000 tons per year P_2O_5) and expansion of the mixed fertilizer plant to increase output of monoammonium phosphate and diammonium phosphate were planned for Annaba.

MINERAL FUELS

Natural Gas.—Algeria's proven reserves of natural gas were estimated to be 3.55 trillion cubic meters in 1976. SONATRACH controlled production, liquefaction, and exportation of natural gas, and Société Nationale Algérienne de l'Electricité et du Gaz (SONELAGAZ) controlled distribution to domestic consumers. In 1976, natural gas production for domestic consumption, reinjection, and exporting LNG was 10.5 billion cubic meters. Estimated gross production was about 21 billion cubic meters. The Camel LNG plant at Arzew operated above capacity, and the three operational lines at the Skikda LNG plant had an output of over 3.2 billion cubic meters in 1976. Construction of line 4 at Skikda continued to encounter technical difficulties, and the expected completion date was moved back from late 1976 to mid-1977. Construction on lines 5 and 6 at Skikda began during the year with completion due in 1979. When the Skikda plant is completed, total output should be 8.4 billion cubic meters per year. In January, Bechtel International Inc. of the United States was awarded a cost-plus contract to complete the large liquefaction plant (LNG–1) at Bettioua near Arzew. SONATRACH had dismissed the original contractor, Chemical Construction Corp. of the United States, late in 1975 because of construction delays. LNG–1 was to begin operations in the fall of 1977. When completed, total capacity of LNG–1 was to be 10.5 billion cubic meters per year. SONATRACH awarded a contract to Pullman Kellog of the United States for a 10.5-billion-cubic-meter-per-year LNG plant (LNG–2) to be built at Bettioua. Besides methane, LNG–2 was to produce 300,000 tons per year of butane and 350,000 tons per year of propane and have provisions for helium production. The $800 million plant was to have six liquefaction lines and to be operational in mid-1979. In July, SONATRACH signed a contract with Foster Wheeler Corp. of the United States for the construction of a huge LNG plant at Arzew. The $1,000 million plant (LNG–3) was to process 15.75 billion cubic meters per year in nine lines and to produce LNG, 500,000 tons per year of propane, and 450,000 tons per year of butane. LNG–3 was to go onstream in 1980.

A Japanese consortium of Japan Gasoline Co., Ltd., and C. Itoh & Co., Ltd., won a $480 million contract to construct two natural-gas-processing plants at the Hassi R'Mel Field from SONATRACH in April 1976. Each plant was to process 20 billion cubic meters per year and to produce 1.7 million tons of liquefied petroleum gas and 8 million tons per year of condensate. The dry gas was to be reinjected, and the output was to be conveyed by pipeline to Arzew. The plants were to be onstream by late 1979. A $237.5 million contract was signed by Algeria and a subsidiary of Ente Nazionale Idrocarburi (ENI) of Italy to construct two natural-gas-reinjection stations at the Hassi R'Mel Field. The plants, scheduled to go on-line in early 1980, would each pump 20 billion cubic meters per year back into the formations.

SONATRACH was actively engaged in negotiating LNG sales contracts with foreign utility companies in 1976. A long-term contract was signed with Distrigas Corp. of the United States for 1.2 billion cubic meters of LNG per year over a 20-year period with deliveries beginning in 1978. Gaz de France signed a 20-year contract to purchase an additional 3.5 billion cubic meters of LNG per year in June with deliveries beginning in 1980. Saar Ferngaz of West Germany negotiated a 1.5-billion-cubic-meter-per-year, 20-year contract with SONATRACH and would start receiving LNG in 1980. ENI of Italy signed a contract with SONATRACH to purchase 8.5 billion cubic meters of LNG per year. The 25-year contract called for LNG deliveries to begin in 1982.

Société d'Etudes du Gazoduc de la Mediterranee Occidentale (SEGAMO), a joint Algerian, French, and Spanish research organization, signed a contract with a French firm to plan a 160-kilometer pipeline from Algeria to Europe. The pipeline would run from the West Algerian port of Oran to Almería in southeastern Spain. The pipeline was expected to carry 40,000 million cubic meters of gas per year for distribution by the Spanish gas company Empresa Nacional del Gas (ENAGAS) and Gaz de

France. Negotiations on the planned natural gas pipeline from Algeria to Sicily through Tunisia remained at a stalemate, and ENI withdrew from the project late in the year.

Petroleum.—Crude oil reserves in Algeria were estimated to be over 10,000 million barrels in 1976. Reserves in the Hassi Messaoud Field, which produced about 50% of Algeria's 1976 output, were about 7,300 million barrels. Crude oil production for the year was 50.099 million tons, or about 1.7% of total world crude output. Of Algeria's over 850 producing wells, nearly one-fourth required artificial lifting in 1976. Over 170 wells were drilled in Algeria during the year, compared with 103 in 1975, by about 80 drilling rigs. No accurate account was available as to the types of wells drilled, but the majority were drilled for production wells, water-injection wells, and natural-gas-reinjection wells.

Petrobás Internacional S.A. (Braspetro) planned to drill two delineation wells between Biskra and Djebel Onk, where its 1975 discovery flowed 35° API crude oil at a rate of 3,465 barrels per day.

Algeria's oil refineries at Arzew, Algiers, and Hassi Messaoud operated at about 86% of capacity in 1976 and had an output of approximately 4.9 million tons. Algeria was making progress on expanding oil refinery capacity with new facilities at Skikda (300,000 barrels per day), Béjaïa (150,000 barrels per day), Hassi Messaoud (13,200 barrels per day), and at In Amenas (3,600 barrels per day). All four were to come onstream by 1980 and quintuple Algeria's oil-refining capacity.

The Mineral Industry of Angola

By Janice L. W. Jolly [1]

Production of goods that formed the mainstay of Angola's prewar exports, including diamond and iron, was still far below the 1973 target that the ruling Movimento Popular para a Libertação de Angola (MPLA) had set as a goal to be again reached. The conflict that accompanied liberation had taken a heavy economic toll, slashing diamond production by 80%, discontinuing iron ore production altogether, and leaving agriculture in such disarray that Angola had to import over half of its food. No reliable figures for the gross domestic product (GDP) are available, but it was estimated at no more than 50% of preindependence levels of $1.8 billion[2] (1973 estimate).[3] Despite the presence of many Cuban, East European, and U.S.S.R. advisors, the economy was almost totally dependent for hard currency revenue on the operations of the Cabinda Gulf Oil Co. Not even in the offshore Cabinda Gulf operations had the 1973 target level of around 160,000 barrels per day been reached. Even so, Angola's oil was yielding an indispensable $400 million per year. State revenues from oil, however, were rapidly being absorbed in infrastructural reconstruction costs, demurrage charges paid at the Luanda port, and the continuing food imports.[4] The MPLA set 1980 as the target date for initial stages of reconstruction.

In early 1976, Angola claimed itself firmly united with Cuba and the U.S.S.R. in a common Marxist ideology. However, the MPLA declared that it was not prepared to do away entirely with the private sector of the economy at the outset. With this short term guarantee against wholesale nationalization, some Angolans who had fled to Portugal were reportedly returning.[5] The Government published a new law regulating State intervention in Angola's economy. The law was in the context of a "resistance economy which must rely fundamentally on national and anti-imperialist forces," as the preamble stated. Under the terms of the law, the State will control what are termed strategic industries while the private sector "must be encouraged and supported by the State as long as it respects the general economic and labor policies defined by MPLA." Nationalization of both Angolan and foreign firms can be ordered by the Revolutionary Council either partially or totally, and the law establishes a list of criteria for such nationalizations, including monopolistic practices, incidence on Angola's foreign exchange, type of production, and whether a firm's continuation under private ownership is considered in the national interest.[6] Angolan officials acknowledged that great sums of financial aid and investment would be needed to develop such major foreign exchange earners as oil, diamond, and iron ore.

The largest task of reconstruction was expected to be that of rebuilding the transportation system. It was reported that 144 bridges were destroyed and that Yugoslav engineers were helping to rebuild them. There was also a shortage of trucks; only 6,000 remained out of the original

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[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Angolan escudos (A. Esc) to U.S. dollars at the rate of A. Esc1 = US$0.0413.

[3] Barclays Bank Country Reports (London). Angola. Oct. 28, 1976, p. 1.

[4] The Financial Times (London). Neto's Confrontation Policy. No. 27,469, Jan. 26, 1978, p. 3.

[5] The Economist (London). Business International. V. 260, No. 6935, July 31, 1976, p. 53.

[6] The Financial Times (London). Angola Zaire Presidents to Meet in Brazzaville. Feb. 28, 1976, p. 4.

24,000 available for distributing merchandise. Before independence, there were 407 civil construction companies, but by 1976, there were only 53 on record and only 7 or 8 that were actually working. The construction materials industry was also practically paralyzed. There was only one ceramic factory functioning in Luanda and that very badly.[7]

In December 1976, Angola was admitted to the United Nations as the 146th member, giving the State international recognition. Even before this, however, aid for reconstruction was pouring in. The Arab League gave $1 million to Angola in February; an additional $1.2 million came from West Germany to finance geological exploration; Brazil loaned $50 million in financial credit; and by the end of October 1976, $2.6 million in aid had been obtained from Denmark, England, Switzerland, Norway, Sweden, Saudi Arabia, the United Nations, and the World Food Program. Donations of food amounted to $7 million. At the end of 1976, East German and Bulgarian technicians were reportedly arriving in Angola to construct two naval bases.[8] Algeria was serving as a major Angolan oil advisor, and Cuba and Angola had signed a series of cooperation agreements covering wide-ranging assistance.

There were no moves to take over Cabinda Gulf or the privately-owned Benguela Railway, although it was reported that the Government was subsidizing railroad employees' salaries (estimated at $1.2 million per month) to keep the railroad going. The Government reportedly resisted demands to hand over control of all nationalized firms to the people who work in them, and it insisted that Government representatives be appointed to the management committees. So far, only the businesses abandoned by departing Portuguese were expropriated; banking was nationalized to facilitate credit for national reconstruction. A cement factory and a metallurgical company of the Champalimaud Group were both nationalized.[9] Portuguese residences that were vacant for more than 45 days were also seized. Of the 6,000 Portuguese estates abandoned, only 1,500 were taken over as part of the massive nationalization program.

National reorganization commissions were formed in mid-1976 including the National Petroleum Industry Reorganization Commission and the National Mining Industry and Geological Activity Reorganization Commission. They were to create organizational conditions for efficient industry management and assist the Secretary of State for Industry and Power in selecting members for responsible positions in the newly organized industries, with particular emphasis on nationalized companies.[10]

In September 1976, the Angolan Government requested that all work be suspended by the South Africans on the Calueque Dam on the Cunene River. The Republic of South Africa had officially withdrawn its troops in March from the power installations located near the South-West African border. The Ruacaná power project was still scheduled to come on-stream in mid-1978, but no more than 80% of the optional output was to be realized unless Angola allowed the Calueque regulating dam to be finished.

PRODUCTION AND TRADE

In 1976, 36.7 million barrels of oil were produced, valued at an estimated $442 million. This represented an overall production decrease of about 37% from that estimated for 1975. The decrease was principally the result of Gulf's shut-in for the first few months of 1976. The Cia. de Petróleos de Angola (PETRANGOL) had nearly tripled crude petroleum production to 44,000 barrels per day by yearend as the Zaire Province increased its output. The PETRANGOL refinery experienced difficulties in operation because of a lack of trained personnel.[11] The refinery produced 5.2 million barrels of refined prod-

[7] Industries et Travaux D'Outre-mer (Paris). Angola. V. 24, No. 275, October 1976, p. 739.
[8] Paris Match (Paris). Technicians in Angola. Jan. 21, 1977, p. 63.
[9] Industries et Travaux D'Outre-mer (Paris). Southern Africa. V. 24, No. 271, June 1976, p. 472.
[10] Marches Tropicaux et Mediterraneens (Paris). Formation of National Industrial Reorganization Commissions. Aug. 30, 1976, pp. 2190–2191.
[11] Diario de Luanda (Luanda). Cia. de Petróleos de Angola, Board of Directors' Annual Report for the Period Ending June 30, 1976. Aug. 31, 1976, pp. 12–14.

ucts despite operating difficulties caused by local disturbances and a lack of specialized personnel. Exports of refined petroleum products were 2,331,000 barrels. The bulk of the exported oil, both crude and refined, went to the United States, Portugal, and Canada.

There was no iron ore production in 1976. West Germany reportedly imported 57,000 tons of iron ore from Angola in 1976, starting with 17,000 tons in February, and continuing periodically until November. There were no exports to the United States and Japan, as in the previous year.

The Zaire-Angola accord was signed in March 1976 pledging a guarantee of each country's territorial integrity. It was hoped the Benguela Railway would rapidly open allowing freer trade once again with both Zambia and Zaire. The railroad remained closed throughout 1976, however, because of effective guerrilla disruption by the União Nacional para a Independência Total de Angola (UNITA), a rival political party. Approximately 800 Zambian freight cars and 70,000 tons of freight including copper and zinc from Zambia and Zaire had been detained since late 1975 at Lobito. At yearend, the Angolan Government was giving assurances that the impounded freight would soon be moved. About 15,000 tons of Zambian copper was believed stranded en route,[12] waiting for two of the main rail bridges to be repaired. In June 1976, the Lobito authorities permitted 2,000 tons of Zambian copper to be loaded on ships destined for West Germany.

[12] Metal Bulletin (London). Not Much Copper at Lobito. Sept. 24, 1976, p. 20.

Table 1.—Angola: Production of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [p]
METALS			
Beryllium, beryl, gross weight [e]	90	30	30
Gold, mine output, metal content—troy ounces	2,000	[e] 1,000	[e] 1,000
Iron ore and concentrate, gross weight—thousand tons	5,600	2,600	--
NONMETALS			
Cement, hydraulic—do	760	700	[e] 600
Clays, kaolin [e]	[r] (2)	[r] (2)	--
Diamond:			
Gem [e]—thousand carats	[r] 1,455	400	250
Industrial [e]—do	[r] 485	135	89
Total—do	1,940	[e] 535	339
Gypsum [e]	40,000	40,000	20,000
Salt [e]	100,000	100,000	100,000
Stone:			
Dimension:			
Granite blocks	[e] 6,000	NA	NA
Marble blocks	[e] 1,000	NA	NA
Other, limestone	[e] 600,000	NA	NA
Talc [e]	100	100	50
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural [e]	40,000	40,000	40,000
Natural gas:			
Gross production—million cubic feet	37,500	35,000	22,000
Marketable production—do	2,400	2,300	2,000
Petroleum:			
Crude—thousand 42-gallon barrels	61,392	57,943	36,700
Refinery products:			
Gasoline—do	546	386	429
Jet fuel—do	563	619	446
Kerosine—do	157	76	136
Distillate fuel oil—do	785	1,072	949
Residual fuel oil—do	2,934	2,635	2,924
Other—do	97	147	120
Other—do	332	135	184
Total—do	5,414	5,070	5,168

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, a variety of crude construction materials, such as clays, sand, gravel, and broken stone presumably was produced for local consumption, but information is inadequate to make reliable estimates of output levels.

[2] Less than ½ unit.

United Kingdom exports to Angola decreased 48%, and its imports from Angola decreased 18%.[13] Brazil was becoming a major trading partner. Angola was rated as Brazil's third most important trading partner after Algeria and Nigeria.

Angolan imports were reported as totaling about $19 million by September 30, 1976. Of this amount, 64% were imported by the State sector and 36% were acquired by the private sector.[14]

COMMODITY REVIEW

METALS

Iron and Steel.—Operation of the Cassinga iron mine ceased in August 1975 as a result of the war. Since then the mine has been effectively closed because of guerrilla activity, loss of experienced mining personnel, sabotage at the mine by departing miners, and a general lack of development funds. The Angolan Government was reportedly seeking new foreign interests to participate in reopening the mine. Between February and November 1976, 57,000 tons of iron ore was exported to West Germany, probably from accumulated stocks. By September 1976, the major commercial port of Moçâmedes was once again in operation after a period of paralysis. The ore port at Saco do Giraul, near the city of Moçâmedes, was not destroyed; all of its loading and unloading facilities were intact. The railroad running from Moçâmedes to Menongue was again operational.

Italian interest in Angola was being shown by the Societá Finanziaria Siderurgica S.p.A. (Finsider) (interested in buying iron ore) and by its subsidiary Italimpianti S.p.A. (interested in a contract for modernization of the steel mill near Luanda). The steelworks was reported to be operating at about 10% of the design capacity.[15]

NONMETALS

Diamond.—In early 1976, Companhia de Diamantes de Angola (DIAMANG) began negotiations with the Angolan Government for control and operation of the diamond mining concessions in northeastern Angola. At yearend, settlement was reported to be imminent, with the State expected to nationalize about 61% of the company in 1977. The company was jointly owned by the Portuguese Government and private shareholders in Portugal, the United Kingdom, the Republic of South Africa, Belgium, and the United States. Angola had an 11.6% share of the company and before the civil war had received half of the profits. During and after the conflict, however, smuggling and personnel problems reached alarming proportions. The strict discipline and hard work required to restore productivity and efficiency were nonexistent. The 1976 diamond production by DIAMANG fell to 339,000 carats,[16] compared with about 2.1 million carats produced in 1973. The sale of diamond from Angola was handled entirely by the Central Selling Organization (CSO) of De Beers Consolidated Mines Ltd. The U.S.S.R. was reportedly trying to take De Beers' place.

MINERAL FUELS

Petroleum and Natural Gas.—Crude oil production fell 37% in 1976 to 102,000 barrels per day. The Cabinda Fields were shut-in from December 22, 1975, to April 29, 1976, while Gulf held the petroleum taxes and royalties in a special account. In March this account, which totaled $102 million including interest, was released to the new Government and Gulf began negotiations to resume oil production. The royalty and tax agreement was reported to be the same as before MPLA took over, although long term negotiations were to continue. In early 1975, the Angolan Government raised oil royalties from 12.5% to 16.7% and the profits tax from 50% to 65.75%. The Angolan Government had also acquired 55% participation in the capital of Gulf. During the year, the anti-MPLA, Liberation Front of the Enclave of Cabinda periodically threatened Gulf's

[13] Standard and Chartered Review (London). Southern Africa. March 1977, p. 8.
[14] Jornal de Angola (Luanda). Interview With Angolan Prime Minister Lopo Fortuanto Ferreira do Nascimento. Nov. 11, 1976, pp. 9, 13, and 15.
[15] Mining Journal (London). Industry in Action. Nov. 26, 1976, p. 424.
[16] Mining Annual Review, 1977. Angola. P. 446.

facilities in the Front's attempts for independence, but this was effectively prevented by Cuban assistance.

Production estimates for the first 6 months of 1976 were down to 33,610 barrels per day[17] for the Cabinda enclave, compared with 141,200 barrels per day for the equivalent 1975 period. By yearend, however, a production rate of about 130,000 barrels per day was being reached. Gulf's total production for 1976 was estimated at 28.5 million barrels from five major fields (Malongo, N.; Malongo, S.; Malongo, W.; Field 95–03; and Field 121–02).

For the year ending June 30, 1976, PETRANGOL reported that production of crude oil had reached a total of 8,296,319 barrels (23,045 barrels per day).[18] Natural gas sales were reported at 9.1 million cubic meters for this period, representing a reduction from the equivalent 1975 period. Distribution of the production was as follows: PETRANGOL, 380 barrels per day of crude oil; PETRANGOL/Soc. Portuguesa Exploraçao de Petróleos Angol SARL (ANGOL) partnership, 5,646 barrels per day of crude oil and 9.1 million cubic meters of gas; and PETRANGOL/ANGOL/Texaco Petróleos de Angola partnership, 17,020 barrels per day of crude oil. While PETRANGOL's crude oil production was at the rate of 13,880 barrels per day for the first 6 months of 1976,[19] this had increased to over 40,000 barrels per day by yearend. There were 851 workers in PETRANGOL on December 31, 1975, when the sudden departure of 115 of the 187 technicians nearly shut down the refinery. The company was forced into an immediate effort to train new persons for these specialized jobs. The first of these trainees were on the job by May 1976.

In June 1975, PETRANGOL acquired landholdings comprising 757 square kilometers in the Congo Basin and 1,447 square kilometers in the Cuanza Basin. Under the terms of partnership contracts and the Government prospecting decree, PETRANGOL retained two-thirds of the Congo areas and half of the Cuanza areas. The study of these areas was to continue until December 1977 under the terms of the contract extension.

Exploration in 1976 was minimal. Texaco had a rig working offshore and shot a short offshore survey. Both American Oil Co. (Amoco) and Sun Oil Co. were inactive. Petrofina S.A. was the only operator to drill, accounting for 33,206 feet. The lack of exploratory drilling in the past 2 years had allowed serious inroads to be made in Angola's reserves. Proved oil reserves were estimated to have dropped about 37 million barrels to 1.321 billion barrels, while gas reserves were depleted by about 300 billion cubic feet to 1.483 trillion cubic feet.[20] The Italian national petroleum company Ente Nazionale Idrocarburi (ENI) was reportedly planning to engage in exploratory drilling in the Cabinda enclave.[21]

In May 1976, a national oil company, Société Nationale des Combustibles de l'Angola (SONANGOL), was set up for undertaking all fuel production and distribution.[22] There were two refineries, one at Luanda with a 21,700-barrel-per-day capacity and the other at Cabinda handling 2,800 barrels per day.

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[17] Oil and Gas Journal. Worldwide Production, Angola. Dec. 29, 1976, p. 89.
[18] Work cited in footnote 11.
[19] Work cited in footnote 17.
[20] World Oil (New York). Angola. V. 185, No. 3, Aug. 15, 1977, p. 154.
[21] Marches Tropicaux et Mediterraneens (Paris). Italy Gains an Economic Foothold in Angola. Dec. 17, 1976, p. 3475.
[22] Industries et Travaux D'Outre-mer (Paris). Western Africa, Mineral Activity. V. 24, No. 272, July 1976, p. 539.

The Mineral Industry of Argentina

By Orlando Martino [1]

The Argentine economy, one of the most industrialized in Latin America, made a modest recovery from the recession that began in 1974. The gross domestic product (GDP) of $37.5 billion [2] grew 1.9%, compared with the annual average growth of more than 5% during 1971–74. The rate of inflation remained high at 344% for the year.

The mineral industry of Argentina, not including mineral fuels (petroleum, natural gas, and coal), represented less than 0.5% of the GDP. In 1976, Argentina did not contribute significant quantities of mineral commodities to world supplies and continued to rely heavily on imports to meet domestic demand for iron ore, copper, coal, alumina, and manganese ore. Nevertheless, mining remained an area of high potential in Argentina.

Despite the depressed situation of the manufacturing and construction industries, there were notable increases in the output of certain metallic and nonmetallic minerals. The inauguration of the new aluminum smelter at Puerto Madryn made it possible for Argentina to sharply reduce imports of aluminum ingot from the high level of 1974. The Dirección General de Fabricaciones Militares (DGFM), the army's industrial complex which holds the largest mining interests in Argentina, reported progress on two large projects: The Sierra Grande iron ore and pellet complex scheduled for completion in August 1978 and the open pit copper project in Catamarca Province. Yacimientos Carboníferos Fiscales (YCF), the Government-owned coal company, suffered from a severe drop in domestic demand for coal, and delayed its expansion plans. The uranium mining project at Sierra Pintada of the Comisión Nacional de Energía Atómica (CNEA) remained in the feasibility study stage. Yacimientos Petrolíferos Fiscales (YPF) and Gas del Estado were active in exploration and expansion of production of petroleum and natural gas.

In the private sector, Compania Minera Aguilar S.A. (CMA), a nearly wholly owned subsidiary of St. Joe Minerals Corp., continued preliminary work on its Pachón copper deposit. Engineering design and financial arrangements were being held up pending approval of the Government's new mining promotion law.

Government Policies and Programs.—The military junta which assumed control of the Government in March 1976 initiated an economic stabilization program to reduce inflation and the balance-of-payments deficit, restore the climate for foreign investment, and establish the basis for a lasting economic recovery. At yearend, it was not clear how this program would affect funding for development projects in the mineral sector.

Another year went by without final Government action on the new mining promotion law, despite high hopes for its approval. Although the Government released large tracts of land from its strategic reserves for private exploration and exploitation and the National Development Bank and the Secretariat of Mining stepped up their support for small- and medium-size mining ventures, it appeared unlikely that there would be any significant activity in the sector until the mining promotion law is published. Approval of the proposed law,

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Argentine pesos (M$N) to U.S. dollars at the 1976 average rate of M$N150=US$1.00. At yearend the rate was M$N275=US$1.00.

reportedly in the final stages of review by the Government, was expected by mid-1978. Considering the beneficial impact that pending investments would have on economic recovery, the Government appeared interested in stimulating foreign investment as a complement to domestic investment.

The Minister of Economy was preparing a new law to regulate risk contracts covering oil exploration in onshore and offshore areas and development of the heavy petroleum resources at Llancanelo. Approval of the new law was expected by mid-1977.

In April, the Government outlined its energy plan under which the role played by natural gas, hydroelectrical power, and nuclear energy is to increase and the role of coal and petroleum is to decrease. In 1976, Argentina's electrical installed capacity rose 8% to 7,876 megawatts. Work proceeded on the $1.3 billion Salto Grande hydroelectric project on Río Uruguay, a combined national effort of Argentina and Uruguay. The 1,890 megawatts of installed capacity are expected to be available in 1980. In 1976, an agreement was signed between Argentina and Paraguay to construct the Yaciretá-Apipé dam on Rio Paraná The $4.5 billion project will provide 4,050 megawatts of energy and is scheduled for completion in 1985.

Argentina signed an agreement with the United Nations Development Program (UNDP) for a $1 million project to explore for metallic minerals in three areas of Chubut Province.

PRODUCTION

The mineral industry of Argentina was geared to the needs of the domestic market, with almost no export orientation. However, the low level of production of strategic commodities such as ores of copper and iron made it necessary to rely heavily on external sources. Argentina produced barely 10% of its demand for iron, and imported all of the alumina for its growing aluminum industry. The country's self-sufficiency in crude petroleum declined to 86%.

The value of mineral output increased substantially, especially that of nonmetallic minerals. Metallic minerals represented only 14% of the total excluding mineral fuels, up from 9% in 1975. There were notable increases in the output of lead and zinc ores. Output of aluminum metal rose sharply as Argentina continued to expand capacity while exploiting its hydroelectric resources. In the mineral fuels sector, the recent declining trend in production of crude petroleum was reversed, although it remained short of the peak output of 1972. Output of coal recovered from the depressed level of 1975. Expansion of production of natural gas, one of Argentina's primary energy sources, continued. Argentina remained the second largest producer of crude petroleum and natural gas in South America.

During 1976, a total of 28,500 persons were employed in the mining sector, primarily in production of limestone (15%), coal (14%), iron and manganese ore (9%), and lead (7%). Oil production employed 20,700.[3]

[3] Dirección Nacional de Económia Minera. Estadística Minera de la República Argentina, Año 1976. Buenos Aires. 1977, p. 125.

Table 1.—Argentina: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 p
METALS			
Antimony, mine output, metal content ---kilograms--	4,500	900	2,200
Beryllium, beryl concentrate, gross weight	269	167	112
Bismuth	50	374	--
Chromium, chromite, gross weight	60	30	--
Columbium-tantalum, columbite-tantalite concentrates, gross weight ---kilograms--	1,695	1,791	282
Copper:			
Mine output, metal content	315	380	265
Smelter [e]	80	80	60
Iron and steel:			
Iron ore and concentrate, gross weight ---thousand tons--	415	286	506
Pig iron ---do---	1,070	1,043	1,310
Ferroalloys, electric furnace ---do---	49	52	e 50
Crude steel ---do---	2,354	2,243	2,449
Semimanufactures [2] ---do---	3,123	2,236	2,004
Lead:			
Mine output, metal content	37,826	30,046	33,004
Smelter	r 37,200	36,000	50,000
Manganese ore and concentrate, gross weight	26,062	51,219	53,086
Silver, mine output, metal content ---thousand troy ounces--	3,101	2,316	2,250
Tin, mine output, metal content	556	538	385
Tungsten, mine output, metal content	94	58	62
Uranium, mine output, U_3O_8 content ---kilograms--	38,019	37,914	205,437
Zinc:			
Mine output, metal content	39,647	37,351	40,593
Smelter	37,200	39,500	35,200
NONMETALS			
Asbestos	896	1,130	889
Barite	36,241	37,431	40,546
Boron minerals, crude	77,989	76,629	80,851
Cement, hydraulic ---thousand tons--	5,392	5,464	5,712
Chalk	52,750	50,013	58,109
Clays:			
Bentonite	r 113,222	126,737	132,313
Foundry clay	500	200	211
Fuller's earth (decolorizing clay)	216	2,927	2,133
Kaolin	93,237	113,482	83,726
Refractory	154,739	154,019	119,233
Other ---thousand tons--	2,283	2,262	2,056
Diatomite	17,069	15,905	13,850
Feldspar	56,953	63,845	68,224
Fertilizer materials:			
Crude, natural phosphates (guano)	279	876	e 1,000
Manufactured: [3]			
Nitrogenous	99,617	47,445	25,466
Phosphatic (Thomas slag)	4,080	3,459	1,693
Ammonia, anhydrous [3]	4,068	1,350	2,592
Fluorspar	40,672	54,358	40,077
Graphite	60	15	145
Gypsum, crude	510,872	612,733	507,125
Lithium, spodumene, and amblygonite, gross weight	164	487	675
Mica:			
Sheet	426	412	329
Waste and scrap	2,771	2,490	2,291
Pigments, natural mineral: Ocher	139	240	174
Precious and semiprecious stones: Amethyst ---kilograms--	1,000	3,000	500
Pumice and related volcanic materials	65,892	59,849	57,593
Rhodochrosite	24	18	11
Salt:			
Rock ---thousand tons--	1	1	1
Solar ---do---	955	1,566	660
Total ---do---	956	1,567	661
Sand and gravel:			
Sand:			
Construction sand ---do---	12,777	13,866	14,893
Silica sand (glass sand) ---do---	158	187	269
Gravel ---do---	5,839	6,382	5,990
Stone:			
Dimension:			
Flagstone	74,634	100,271	84,472
Granite:			
Blocks	34,250	32,919	24,699
Other forms	9,200	8,825	8,250
Marble and other calcareous stone, n.e.s	27,010	36,026	50,675
Sandstone ---thousand tons--	80	49	48

See footnotes at end of table.

Table 1.—Argentina: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
NONMETALS—Continued			
Stone—Continued			
Crushed, broken, unspecified:			
Aragonite ---thousand tons--	1	11	6
Basalt ---do---	4,127	2,151	2,517
Calcite, nonoptical ---do---	13	17	12
Dolomite ---do---	208	239	245
Granite, crushed ---do---	5,296	4,936	4,343
Limestone ---do---	12,660	12,824	13,608
Marble, rubble ---do---	95	58	69
Quartz ---do---	120	134	116
Quartzite ---do---	1,718	1,362	1,269
Serpentine ---do---	35	40	56
Shell marl ---do---	645	637	605
Tuff ---do---	1,693	1,757	2,006
Strontium minerals, celestite	300	1,467	2,054
Sulfates, natural:			
Aluminum (alum)	16,987	24,806	24,800
Iron (melanterite)	25	--	--
Magnesium (epsomite)	9,953	6,261	12,412
Sodium (mirabilite)	38,107	51,392	35,489
Sulfur, elemental, refined	47,297	30,897	38,954
Talc and related materials:			
Pyrophyllite	5,412	8,357	9,132
Steatite	460	328	840
Talc	34,698	40,081	44,185
Vermiculite	3,825	3,412	4,098
Zeolites	24	25	23
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	2,173	4,424	818
Carbon black [e]	30,000	30,000	30,000
Coal, bituminous ---thousand tons--	626	502	615
Coke, all types, including breeze ---do---	650	766	738
Gas, natural:			
Gross ---million cubic feet--	[r] 318,484	362,860	384,218
Marketed ---do---	[r] 264,859	277,960	290,780
Natural gas liquids:			
Natural gasoline ---thousand 42-gallon barrels--	476	472	[e] 3,700
Butane ---do---	1,525	1,687	
Propane ---do---	1,433	1,539	
Total ---do---	3,434	3,698	[e] 3,700
Peat, agricultural	10,132	24,611	9,532
Petroleum:			
Crude ---thousand 42-gallon barrels--	151,110	144,364	145,561
Refinery products:			
Gasoline ---do---	38,542	32,475	34,071
Jet fuel ---do---	2,729	3,598	3,784
Kerosine ---do---	6,449	6,104	6,178
Distillate fuel oil ---do---	39,499	39,834	42,849
Residual fuel oil ---do---	47,183	53,885	53,199
Lubricants ---do---	1,778	1,784	1,615
Other:			
Liquefied petroleum gas ---do---	10,425	7,057	7,369
Asphalt ---do---	2,804	2,615	2,711
Petroleum coke ---do---	2,610	4,179	--
Unspecified ---do---	--	507	--
Refinery fuel and losses ---do---	17,804	5,798	13,882
Total ---do---	169,823	157,836	165,658

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the commodities listed, cadmium, lime, perlite, and urea are also produced, but output is not reported quantitatively, and available information is inadequate to make reliable estimates of output levels. Titanium-bearing iron sands are also produced, with an annual production of approximately 100 tons of contained metal, but recovery of titanium oxides is not attempted and the material is used for nonmetallurgical purposes.

[2] Hot-rolled semimanufactures only; excludes castings and cold-rolled semimanufactures produced from imported hot-rolled semimanufactures.

[3] Data are for years ending June 30 of that stated.

TRADE

The deficit in the balance of trade in 1974 and 1975 was eliminated in 1976 with a trade surplus of $845 million. In April, the new Government initiated a stabilization policy, counting upon a favorable trade balance as the first step toward recovery. Total exports in 1976 with an f.o.b. value of $3.89 billion were 30% over those of 1975 and were predominantly agricultural. Exports of minerals and mineral fuels of about $27 million represented a very small part of total exports. Following, in thousand dollars, are significant mineral exports with an f.o.b. value exceeding $100,000:

Petroleum products	$17,840
Borates	4,039
Salt	936
Granite	865
Bentonite	823
Gypsum	357
Fluorspar	305
Marble	168

Total imports in 1976 were valued (c.i.f.) at $3.05 billion, a 23% decrease from those of 1975. Argentina's imports of minerals and mineral fuels represented one-third of the total value of imports and played a more significant role than exports of the same. Imports of mining machinery, which had decreased in 1975, increased in 1976 as import restrictions were partially lifted. Imports of natural gas from Bolivia and Chile increased 21% in volume. The sharp reduction in imports of aluminum reflected Argentina's progress in building up domestic productive capacity at Puerto Madryn. The main imports from the United States in 1976 were coal ($55.8 million) and iron and steel scrap ($30.2 million). Brazil was the main source of crude petroleum.

Table 2.—Argentina: Imports of selected mineral commodities, by value

(Thousand dollars)

Commodity	1975	1976
Iron and steel products	807,195	393,813
Crude petroleum	222,810	289,050
Refined petroleum products	185,153	168,600
Coal	95,966	70,322
Natural gas	43,200	66,501
Iron ore and pellets	52,816	60,727
Copper	56,223	41,377
Aluminum	61,534	19,849
Manganese ore	4,876	3,796
Other	78,587	12,796
Total	1,608,360	1,126,831

Table 3.—Argentina: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Oxide (alumina) and hydroxide	4	2
Metal including alloys, all forms	2,474	89
Antimony ore and concentrate	2	--
Beryllium, beryl ore and concentrate	75	150
Chromium oxide and hydroxide	5	(1)
Copper metal including alloys, all forms	944	130
Iron and steel:		
Pig iron and similar materials	1	23
Ferroalloys	30	30
Steel, primary forms	6,223	--
Semimanufactures:		
Bars, rods, angles, shapes, sections	223,233	4,032
Universals, plates, sheets	46,845	585
Hoop and strip	1,741	73
Rails and accessories	405	488
Wire	19,824	3,103
Tubes, pipes, fittings	43,809	24,556
Castings and forgings, rough	1,146	198
Lead:		
Oxide	(1)	2
Metal including alloys, all forms	2	1
Magnesium metal including alloys, all forms	16	25
Mercury ---------- 76-pound flasks	(1)	--
Silver metal ---------- thousand troy ounces	6	(1)
Tin:		
Ore and concentrate	3,788	1,918
Metal including alloys, all forms	46	3
Tungsten:		
Ore and concentrate	22	--
Metal including alloys, all forms	(1)	--
Uranium and thorium:		
Oxides, including rare-earth oxides ---------- kilograms	202	--
Metals including alloys, all forms ---------- do	800	--
Zinc:		
Oxides	230	--
Metal including alloys, all forms	470	1
Other:		
Ash and residue containing nonferrous metals	479	39
Oxides, hydroxides, peroxides of metals, n.e.s	26	--
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	(1)	--
Grinding and polishing wheels and stones	47	248
Asbestos	(1)	--
Barite	864	146
Boron materials:		
Crude natural borates	7,360	4,167
Oxide and acid	1,026	110
Borates and perborates	14,099	9,172
Cement	8,724	2,086
Chalk	76	304
Clays and clay products (including all refractory brick):		
Crude:		
Bentonite	16,521	6,560
Kaolin	117	--
Other	298	51
Products:		
Refractory (including nonclay bricks and cement)	859	743
Nonrefractory	1,096	299
Diatomite and other infusorial earth	74	10
Feldspar	(1)	6
Fertilizer materials:		
Manufactured:		
Nitrogenous	6	33
Phosphatic (Thomas slag)	--	184
Mixed	358	90
Ammonia	510	211
Fluorspar	995	2,034
Gypsum and plasters	16,809	23,372
Lime	163	96
Lithium and lithium compounds	40	45
Magnesite	1	--
Mica:		
Crude, including splittings and waste	1,332	223
Worked, including agglomerated splittings	r 1,020	--

See footnotes at end of table.

Table 3.—Argentina: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS—Continued		
Pigments, mineral:		
Natural, crude	5	(1)
Iron oxides, processed	1,020	124
Precious and semiprecious stones, except diamond, natural ---kilograms	347	3,057
Salt	82,583	54,535
Sodium and potassium compounds, n.e.s	(1)	--
Stone, sand and gravel:		
Dimension stone:		
Crude	14,689	5,875
Worked	866	1,149
Dolomite	2,134	2,272
Gravel and crushed rock	57,783	26,032
Ornamental stone:		
Onyx	(1)	--
Rhodochrosite	51	5
Quartz	5	--
Sand	18,988	4,933
Sulfur:		
Sulfur dioxide	6	(1)
Sulfuric acid	324	131
Talc, steatite, soapstone, pyrophyllite	670	271
Other:		
Crude	57	122
Slag, dross, and similar waste, not metal bearing	681	1,093
Bromine, iodine, fluorine	6	5
Oxides, hydroxides, peroxides of strontium, barium, magnesium	30	46
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	76	62
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	633	273
Carbon black	8,536	4,062
Coal, all grades	3,011	1,438
Coke and semicoke	27	66
Rare gases, argon and other	8	--
Petroleum refinery products:		
Gasoline ---thousand 42-gallon barrels	151	3
Distillate fuel oil ---do	--	8
Residual fuel oil ---do	103	5
Lubricants ---do	55	53
Other:		
Liquefied petroleum gas ---do	8	35
Mineral jelly and wax ---do	23	20
Bitumen and other residues ---do	48	26
Bituminous mixtures, n.e.s ---do	23	34
Petroleum coke ---do	117	1,032
Unspecified ---do	(1)	(1)
Total ---do	528	1,216
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	23	9

r Revised.
1 Less than ½ unit.

Table 4.—Argentina: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite and concentrate	38,673	29,071
Oxide (alumina) and hydroxide	13,305	105,499
Metal including alloys, all forms	86,514	51,642
Antimony:		
Ore and concentrate	323	580
Metal including alloys, all forms	(1)	(1)
Arsenic:		
Trioxide and acids	438	367
Metal including alloys, all forms	9	1
Bismuth:		
Ore and concentrate	3	--
Metal including alloys, all forms	20	20
Cadmium metal including alloys, all forms	(1)	2
Chromium:		
Chromite	5,250	5,708
Oxide and hydroxide	11	6
Metal including alloys, all forms	2	8
Cobalt:		
Oxide and hydroxide	12	12
Metal including alloys, all forms	128	84
Columbium and tantalum: Tantalum metal including alloys, kilograms	29	19
Copper:		
Ore and concentrate	3,086	2,044
Metal including alloys, all forms	46,174	42,575
Gold metal, unworked or partly worked, troy ounces	11,478	73,336
Iron and steel:		
Ore and concentrate, thousand tons	1,003	1,520
Metal:		
Scrap, do	148	319
Pig iron, including spiegeleisen, do	147	179
Sponge iron, powder, shot	2,366	1,135
Ferroalloys	9,643	10,828
Ingots and other primary forms, thousand tons	1,153	1,194
Semimanufactures:		
Bars and rods, do	5	11
Angles, shapes, sections, do	17	30
Universals, plates, sheets, do	256	473
Hoop and strip, do	3	4
Rails and accessories	289	263
Wire	133	305
Tubes, pipes, fittings, thousand tons	14	9
Castings and forgings	285	115
Lead:		
Ore and concentrate	2,268	5,143
Oxides	132	301
Metal including alloys, all forms	1,763	6,116
Magnesium metal including alloys, all forms	462	481
Manganese:		
Ore and concentrate	98,673	77,619
Oxides	1,362	903
Metal	43	75
Mercury, 76-pound flasks	1,716	1,153
Molybdenum:		
Ore and concentrate	40	5
Metal including alloys, all forms	14	13
Nickel metal including alloys, all forms	1,252	1,077
Platinum-group metals and silver:		
Platinum-group, troy ounces	234,989	2,765
Silver, thousand troy ounces	1,422	753
Rare-earth metals and compounds	62	51
Selenium, elemental	14	8
Tellurium, kilograms	198	703
Tin metal including alloys, all forms	2,018	1,777
Titanium:		
Ore and concentrate	2,433	1,568
Oxides	1,241	545
Metal including alloys, all forms	13	21
Tungsten metal including alloys, all forms	7	8
Zinc:		
Ore and concentrate	24,217	23,315
Oxides	36	131
Metal including alloys, all forms	1,447	4,744
Zirconium ore and concentrate	20	108
Other:		
Ores and concentrates	1,219	744
Oxides, hydroxides, peroxides of metals, n.e.s	504	476

See footnote at end of table.

Table 4.—Argentina: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS—Continued		
Other—Continued		
Metals including alloys, all forms:		
Metalloids	4,341	3,972
Pyrophoric alloys ---kilograms--	581	461
Base metals including alloys, all forms, n.e.s	1	2
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	364	571
Dust and powder of precious and semiprecious stones	8	2
Grinding and polishing wheels and stones	111	93
Asbestos	17,831	15,548
Barite and witherite	3,566	2,806
Boron materials:		
Borates and perborates	114	50
Boric acid	3	2
Bromine	100	84
Cement	11,491	30,533
Chalk	308	271
Clays and clay products (including all refractory brick):		
Crude:		
Bentonite	4	4
Fire clay	190	118
Kaolin	17,812	12,400
Andalusite, kyanite, sillimanite	507	57
Other	2,656	98
Products:		
Refractory (including nonclay bricks)	26,767	29,870
Nonrefractory	1,794	3,428
Cryolite and chiolite	10	34
Diamond:		
Industrial ---value, thousands--	$717	$1,807
Powder ---thousand carats--	211	157
Diatomite and other infusorial earth	4,353	2,351
Feldspar and fluorspar	905	--
Fertilizer materials:		
Crude:		
Nitrogenous	23,417	6,436
Phosphatic	11,400	7,750
Manufactured:		
Nitrogenous	13,473	6,085
Phosphatic	38,570	20,174
Potassic	15,747	5,628
Mixed	33,032	15,724
Ammonia	2	1
Graphite, natural	705	488
Iodine	124	57
Magnesite	22,290	21,036
Mica:		
Crude, including splittings and waste	20	48
Worked, including agglomerated splittings	15	15
Pigments, mineral:		
Natural, crude	1	(1)
Iron oxides, processed	215	275
Precious and semiprecious stones, except diamond ---thousand carats--	3,875	197
Pyrite	55	30
Salt and brine	10	12
Sodium and potassium compounds, n.e.s.:		
Caustic soda	92,780	84,119
Caustic potash, sodic and potassic peroxides	1,113	741
Sodium carbonate, natural and manufactured (soda ash)	166,866	178,746
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	2,092	2,052
Worked	10	20
Dolomite, chiefly refractory grade	5,714	3,704
Gravel and crushed rock, n.e.s	17,270	102,959
Quartz and quartzite	352	529
Sand, excluding metal bearing ---thousand tons--	72	65
Sulfur:		
Elemental:		
Other than colloidal	78,497	97,221
Colloidal	83	69
Sulfuric acid	41	7
Talc, steatite, soapstone, pyrophyllite	521	489
Other:		
Crude	888	708
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture	30	15

See footnote at end of table.

Table 4.—Argentina: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
NONMETALS—Continued			
Other—Continued			
Oxides, hydroxides, peroxides of strontium, barium, magnesium		544	227
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s		9	5
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		109	106
Carbon black		1,019	567
Coal, all grades, including briquets	thousand tons	822	1,030
Coke and semicoke	do	5	6
Gas, natural	million cubic feet	52,513	55,691
Hydrogen and rare gases	kilograms	325	5
Peat		272	125
Petroleum:			
Crude	thousand 42-gallon barrels	21,572	15,635
Refinery products:			
Gasoline	do	602	409
Kerosine	do	34	376
Distillate fuel oil	do	1,094	3,157
Residual fuel oil	do	945	125
Lubricants	do	18	145
Other:			
Liquefied petroleum gas	do	22,796	20,281
Nonlubricating oils, n.e.s	do	1	1
Other	do	39	6
Total	do	25,529	24,500
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		82,933	58,154

[1] Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—Although Argentina's first smelter, operated since 1974 by Aluminio Argentino S.A.I.C. (ALUAR), had a rated annual capacity of 140,000 tons, it was operating at a level of only 50,000 tons. Aluminum output was limited by the restricted power available from the Futaleufú hydroelectric station, originally scheduled for completion in July 1975 and subsequently for May 1978. Aluminum production was projected at 85,000 tons in 1978, 132,000 tons in 1979, and at full capacity of 140,000 tons in 1980. Reportedly, ALUAR's capacity will be more than doubled in the 1981–86 period. Most of ALUAR's feedstock was purchased under contract from Alcoa of Australia Ltd. in the form of calcined alumina. Domestic supply was augmented by a secondary recovery plant. The demand for aluminum continued at a low level, owing in part to the rise in international prices and the general recession in the industrial sector.

Table 5.—Argentina: Aluminum statistics

(Metric tons)

Year	Primary production	Secondary production	Imports of ingot		Apparent consumption [1]
			From United States	Total	
1970	--	5,500	26,164	50,701	56,596
1971	--	8,000	9,235	59,337	67,743
1972	--	8,000	14,717	72,800	88,801
1973	--	8,000	21,265	69,030	81,297
1974	999	9,500	9,801	85,556	95,277
1975	23,710	10,500	5,714	45,813	79,761
1976	43,122	9,500	4,181	20,232	70,741

[1] Excludes stock variations.

Source: Consejo Tecnico de Inversiones S.A. (Buenos Aires). Anuario—1977, The Argentine Economy. 1977, p. 249.

Copper.—Argentina continued to be heavily dependent on imports to meet its demand for primary copper. CMA completed a capital cost feasibility study on the Pachón mine-mill-smelter complex in San Juan Province. The porphyry copper deposit discovered by CMA in the 1960's was estimated by St. Joe to contain 790 million tons of ore grading 0.59% copper and 0.016% molybdenum. Construction of an improved access road to the Pachón site was underway. The company expected to initiate negotiations with the Argentine Government in early 1977 concerning development and financing of the $940 million copper project. Detailed engineering design would begin in 1978, and output in 1980 would be at the rate of 100,000 tons per year of refined copper.

Yacimientos Mineros de Agua de Dionisio (YMAD), the State mining company located at Belén, Catamarca Province, was conducting its own prefeasibility study of the $600 million Alumbrera copper project to produce 50,000 tons of refined copper per year. YMAD expected to call for proposals for a full feasibility study in late 1977. Estimated reserves of sulfide ores were revised upward to 330 million tons grading 0.5% copper, with small amounts of gold and molybdenum which give an equivalent grade of 0.85% copper. YMAD continued exploration of the nearby El Durazno copper deposit.

Iron Ore.—Construction of the Sierra Grande mine, concentrator, and iron ore and pellet complex in Río Negro Province was nearing completion. Although the deposit was discovered in 1945, implementation of the project by Hierro Patagónica Sociedad Anónima Minera (HIPASAM) did not begin until 1970. The underground mine with a capacity of 3.5 million tons of crude ore per year was expected to begin operations in November 1977. The 2.0-million-ton-per-year pellet plant, connected to the mine by a slurry pipeline, was under construction at the port of San Matías and was scheduled for startup in mid-1978. Resrves of magnetitic iron ore averaging 55% iron at Sierra Grande were estimated at 500 million tons with 150 million tons currently recoverable.

Argentina continued to rely heavily (about 90%) on imports of iron ore to meet domestic demand. In 1976, imports of iron ore, mainly from Brazil, Chile, and Bolivia, amounted to 1.74 million tons, a 15% increase over 1975 imports, which were valued at $60.7 million. Output from the Sierra Grande mine will improve the country's iron ore situation but will not close the gap between domestic production and the requirements of the national iron and steel plan. Local supplies of iron ore came from Zapla Steel Co.'s mines, primarily in Río Negro Province (80%) and also in the Provinces of Jujuy and Salta (at Unchime).

Iron and Steel.—Production of crude steel recovered from the depressed level of 1975 to a record high of 2.4 million tons. Domestic steel demand, however, was slack. The State enterprises maintained a normal rate of activity by building up inventories. Most raw materials for Argentina's steel industry, such as iron ore, coke, and ferroalloys, were imported. Metallurgical coke, imported mostly from the United States, was mixed with Río Turbio coal. The limited domestic output of ferroalloys was mostly ferromanganese.

The newest and largest blast furnace of Sociedad Mixta Siderurgia Argentina (SOMISA) went out of service in August and was not expected to resume operation until early 1977. During 1976, SOMISA completed its expansion program to 2 million tons. Certain civil works were initiated and equipment purchased under the plan to expand production further to 4 million tons.

Propulsora Siderúrgica S.A., the second largest steel producer, took steps to optimize its operations and expand its capacity for production of cold-rolled laminates to 130,000 tons per year. For the longer term, expansion to 1 million tons of cold-rolled steel sheet was foreseen.

In 1976, Dálmine Siderca S.A.I.C. started up Argentina's first direct-reduction plant using the Midrex process at Campana, Buenos Aires Province, on Río Paraná. Initial output of sponge iron was 320,000 tons. Expansion of the Dálmine Siderca steelworks to 365,000 tons per year was expected to be completed by mid-1977. In a second stage, expansion to 530,000 tons per year was contemplated.

Acindar Industria Argentina de Aceros S.A., the leading steel company in the private sector, initiated construction on a major integrated steelplant approved by the Government in 1975. The first of two

stages to be completed by 1978 involved installation of a 462,000-ton-per-year Midrex direct-reduction plant. The second stage of the $180 million program would increase direct-reduction capacity to 600,000 tons per year and provide a third electric furnace. The plant site is at Villa Constitución, Santa Fe Province, 247 kilometers northwest of Buenos Aires.

Lead.—Mine production of lead increased in 1976, but was insufficient to meet domestic demand. Lead was mined from vein deposits in the Provinces of Jujuy, Río Negro, San Juan, and Chubut, with 90% of the output from Jujuy. CMA, a leading lead and zinc producer from the Aguilar mine in Jujuy Province, reported output of 46,600 tons of lead concentrate in 1976, a 13% increase over the revised 41,400 tons of concentrate in 1975.

Manganese.—Manganese demand has been closely linked to the development of Argentina's steel industry. Although imports of manganese ore and concentrate have been declining, they remained important in meeting the country's supply deficit. This deficit will be partially covered by output from the Farallón Negro mines and industrial plant in Catamarca Province, under development by YMAD. Mine development was expected to be completed in mid-1977 with an output of 25,000 tons of ore, and the Farallón Negro plant was scheduled to be operational in early 1978 for production of sinterized manganese concentrate with a minimum content of 40% manganese. Gold and silver will be recovered as byproducts. Estimated ore reserves at Farallón Negro with an average grade of 16% manganese would provide for a mine life of 23 years.

Silver.—Silver was produced primarily as a byproduct of lead and zinc mine operations. CMA reported that lead concentrate produced in 1976 from the Aguilar mine contained 1.75 million troy ounces of silver, a slight decline from the 1975 silver content. The Farallón Negro mine and plant were expected to produce 95,000 troy ounces of silver and 19,600 troy ounces of gold.

Tin.—Argentina's demand for tin was partially met by domestic mine production. Known tin deposits are located in the Provinces of Catamarca, La Rioja, and Jujuy, but practically all of the output in 1976 was from the La Puna area of Jujuy.

Zinc.—Mine output rebounded from the depressed level of 1975, increasing 9% in terms of zinc content. Zinc was being mined primarily in areas of lead production, with 98% coming from Jujuy Province. CMA reported output for 1976 of 89,300 tons of zinc concentrate, an 8% increase over the revised 1975 output of 82,380 tons. Imports of zinc concentrate dropped sharply, in line with increased domestic output.

NONMETALS

Cement.—The portland cement industry comprised seven companies operating 17 plants with a total installed capacity of 8.7 million tons per year. The industry has grown in spurts since 1967 (when annual capacity was 5.0 million tons) but at a rate generally sufficient to meet demand. The largest company operating in 1976 was Loma Negra Compania Industrial Argentina S.A., whose five plants have a total capacity of 4.3 million tons per year. Planned new plants and renovation of existing ones were expected to increase capacity by 2.8 million tons per year at a cost of $300 million.

Clays.—*Bentonite.*—Argentina was the second largest producer of bentonite in Latin America, producing about 35% of the region's total. The level of output made it possible to export almost 15% of the total. Exports were chiefly to Brazil and Chile.

MINERAL FUELS

The energy plan for Argentina as prepared by the Secretary of Energy is summarized as follows, in terms of the percentage composition of the energy demand by source:

Energy source	National energy resource potential (percent)	Energy demand (percent)		
		1975	1980	1985
Petroleum	16	62.5	56.0	51.5
Natural gas	7	22.9	26.3	27.3
Coal and charcoal	13	8.5	7.9	7.7
Hydroelectrical energy	53	4.4	8.4	10.5
Nuclear energy	11	1.7	1.4	3.0

The energy plan was based on a GDP growth rate of 5.5% and an energy demand growth rate of 4.6%. A main objec-

tive of the plan was to reduce the relative importance of nonrenewable energy resources. By 1985, Argentina expects to become self-sufficient in petroleum and almost self-sufficient in natural gas. The relative importance of hydroelectrical power and nuclear energy was to increase. It was predicted that by the year 2000 Argentina will have 15,000 megawatts of installed nuclear capacity. Argentina's 4.4% dependency on hydroelectric sources contrasts sharply to Brazil's 23.8% share.

Coal.—Production of coal continued to fall short of the goals set in 1972 by the Government coal-mining agency YCF to produce 3 million tons by 1975 and 8 million tons by 1980. Argentina's coal production goals were revised to more modest levels in the energy plan as follows:

	Coal supply and demand projections (thousand metric tons)		
	1975	1980	1985
Demand	2,070	2,900	4,400
Production	500	1,500	2,500
Imports	1,570	1,400	1,900

Output of coal in 1976, primarily from YCF's Río Turbio operations, recovered from the depressed level of 1975, increasing 23%. Consumption at the mines was 48,413 tons. Coal imports, mostly metallurgical-grade bituminous coal, were almost all for SOMISA and came chiefly from the United States and Poland. Total imports of 833,122 tons, a 19% decrease from 1975 imports, made up more than one-half of total coal consumption. Imports of anthracite totaled 1,680 tons and of coke, 1,200 tons. The average c.i.f. values of imported bituminous coal, anthracite, and coke were $82, $193, and $258 per ton, respectively. During most of 1976, shipments of domestic coal from Puerto Gallegos were hampered by a lack of ships to transport coal to the distant steel companies north of Buenos Aires. Toward yearend, the situation became worse, and the Coal Board apparently had found no solution to the transport bottleneck. It appeared that private enterprise would participate in the long-distance transport of coal.

Argentina's measured coal reserves, detailed in table 6, were 285 million tons, located primarily in the Río Turbio coalfield. At the current rate of production, reserves are adequate for hundreds of years.

Table 6.—Argentina: Coal reserves

(Thousand metric tons)

Coal type[1]	Coalfield	Province	Reserves			
			Measured	Indicated	Inferred	Total
Semianthracite	Cervantes	Mendoza	--	--	100	100
Bituminous, low-volatile.	La Negra	La Rioja	8	17	30	55
Bituminous, medium-volatile.	Río Tambillos	----do	390	90	90	570
Do	several fields	Mendoza and Neuquén.	--	--	85	85
Bituminous, high-volatile A.	La Delfina	San Juan	--	--	50	50
Bituminous, high-volatile B.	Pico Quemado	Río Negro	75	650	1,915	2,640
Do	several fields	Neuquén, Chubut, San Juan.	--	--	1,460	1,460
Subbituminous A	Río Turbio	Santa Cruz	284,700	257,900	8,200	550,800
Subbituminous A/C.	Cabo Curioso	----do	12	2	1	15
Do	several fields	Chubut and Santa Cruz.	--	--	955	955
Total			285,185	258,659	12,886	556,730

[1] Classified according to the American Society for Testing and Materials.

Source: Energy Plan for Argentina, 1976.

Natural Gas.—Argentina continued to expand its production of natural gas. The need to substitute gas for petroleum and compensate for declining petroleum production has provided impetus for the increased output of natural gas. According to the energy plan, the share of natural gas will be expanded from 23% of total energy demand in 1975 to 27% in 1985.

Toward the end of 1976, gas demand was further increased with the inauguration of the first direct-reduction plant of the Dálmine Siderca steel company, to be joined in 1978 by a similar plant being built by Acindar. Completion of the Futaleufú hydroelectric plant, however, will save the gas supply to the ALUAR aluminum plant and help alleviate the acute gas supply shortage.

Strong demand in 1976 necessitated increasing imports of natural gas from Chile by way of the trans-Andean pipeline, but most imports came from Bolivia by way of the Campo Durán-Buenos Aires pipeline. Bolivia has been an important source of gas imports since the Santa Cruz-Yacuiba pipeline was completed to the Argentine border in April 1972. Gas imports from Bolivia in 1976 were valued at $54.6 million. In January, a new gas price of $0.82 per thousand cubic feet was negotiated with the Bolivian Government, compared with the price of $0.35 prevalent before the renegotiation of late 1974. Under the new sales agreement, gas imports from Bolivia would increase 50% beginning in 1979.

Argentina continued to expand and integrate its gas transport system. In late 1976, Gas del Estado, a Government entity, initiated work on the $210 million Austral gas pipeline to utilize the rich gas reserves of the Tierra del Fuego fields, estimated at 1.06 trillion cubic feet. Completion of the 205-kilometer pipeline, to run from San Sebastián to Cerro Redondo where it will connect with the main southern trunkline, was scheduled for 1977 but has been delayed until 1978–79. The Inter-American Development Bank is participating in the project with an $87 million loan to Gas del Estado.

According to Government sources, total proven gas reserves at yearend were estimated at 6.7 trillion cubic feet, mostly in the region of Patagonia.

Table 7.—Argentina: Production and imports of natural gas

Year	Production, marketed		Imports		Import value	
	Million cubic feet	Percent change from previous year	Million cubic feet	Percent change from previous year	Millions	Percent change from previous year
1972	r 214,536	NA	35,491	NA	$10.0	NA
1973	r 244,376	+14	55,444	+56	18.4	+84
1974	r 264,859	+8	52,513	−5	29.6	+61
1975	277,960	+5	55,691	+6	43.2	+46
1976	290,780	+5	67,663	+21	66.5	+54

r Revised. NA Not available.

Petroleum.—Production of crude oil increased slightly in 1976, reversing the declining trend of 1973–75. By yearend, the production rate had increased 12% to 426,000 barrels per day. This increase represented an improvement in the operating efficiency of YPF since there was no output from new investments during the year. Primary recovery accounted for 90% of the total, and 10% was obtained by secondary recovery. The Government was planning to increase secondary recovery output to 40% of total production. YPF accounted for 108 million barrels or 74.5% of the country's output.

With the decline in self-sufficiency to 86%, Argentina spent $298 million in 1976 to import 22.1 million barrels of crude oil, a 41% increase over the volume of 1975. Argentina planned to reduce imports to 10 million barrels by 1980 and to become self-sufficient in crude oil by 1985. Brazil provided 43% of Argentina's crude oil imports, Gabon 25%, and Bolivia 11%.

During 1976, a total of 503 wells were drilled, compared with 547 wells in 1975

and 606 wells in 1974. Of the total, 324 wells were capable of producing oil in commercial quantities and 42 wells were suitable for gas production. Proved reserves of oil, mostly in the regions of Comahue and Patagonia, were estimated at 2.5 billion barrels. Of all the South American countries, Argentina was considered to possess the largest potential for new oil discoveries, especially in the Provinces of Salta, Jujuy, and Tucumán, where numerous large anticlines remained undrilled. Considerable potential also exists offshore. It has been estimated that the oil potential of the Argentine Continental Shelf may be four times larger than that of the U.S. Atlantic Continental Shelf.[4] The Government of Argentina was negotiating with Geophysical Service, Inc., a U.S. company, to undertake seismic studies of Argentina's Continental Shelf during the period of October 1977 to September 1978.

The semisubmersible platform *General Mosconi,* purchased by YPF from Compagnie Française d'Entreprises Telligues, arrived in Argentina during 1976 and was expected to begin offshore drilling operations in early 1977.

YPF was evaluating proposals for primary and secondary recovery operations at the following oilfields: Centenario and Neuquén del Medio (Neuquén Province); Veinticinco de Mayo (La Pampa Province); Medanito and Medianera (Río Negro Province); Cañadón Seco, Meseta Espinosa, Piedra Clavada, and El Cordón (Santa Cruz Province); and Refugio Tupungato (Mendoza Province).

YPF was preparing an international tender for the recovery of heavy petroleum from a field located near Llancanelo Lake, 40 kilometers southeast of Malargüe, Mendoza Province. Reserves of this heavy oil in the Neuquén Basin have been estimated at 943 million barrels. The feasibility of recovering the Llancanelo reserves depends on the use of appropriate technology.

According to Argentina's energy plan, $9.5 billion of the $20 billion to be spent in the next decade would be for petroleum development. Government projections indicated that Argentina's annual petroleum consumption would reach 198 million barrels in 1980 and 233 million barrels in 1985.

Table 8.—Argentina: Production, trade, and self-sufficiency of crude petroleum

(Million 42-gallon barrels)

Year	Production	Imports	Exports [1]	Apparent demand	Self-sufficiency (percent)
1940	20.7	3.8	--	34.0	61
1950	23.5	35.7	--	65.7	36
1960	r 63.9	23.2	--	99.5	64
1965	98.3	26.4	5.6	125.6	78
1970	143.4	10.6	1.1	158.9	90
1971	154.5	r 16.0	1.3	173.1	89
1972	r 158.5	10.9	.7	169.4	94
1973	r 153.7	r 21.4	.5	178.9	86
1974	151.1	21.6	1.1	173.5	87
1975	144.4	15.6	1.8	163.0	89
1976	145.6	22.1	2.0	169.4	86

r Revised.

[1] Includes derivatives. Exports of crude oil alone averaged 233,200 barrels per year during 1970–75 and were shipped to Chile, the United States, and Paraguay.

Source: Consejo Tecnico de Inversiones S.A. (Buenos Aires). Anuario—1977, The Argentine Economy. 1977, p. 171.

Uranium and Nuclear Energy.—The uranium mining project of Sierra Pintada, located 20 kilometers south of San Rafael in Mendoza Province, was stalled for several months over a dispute between CNEA and the contractor for the feasibility study of the open pit mining project and design of the plant to produce yellowcake. It appeared that the contract would be abrogated. Once a new contract is signed, it would be 3 or 4 years before initial production. The project was expected to produce 720 tons of yellowcake per year. The Sierra Pintada deposit, discovered in 1968, has reserves of 12,000 tons of U_3O_8 and is Argentina's largest deposit. Although

[4] Grossling, B. F. Latin America's Petroleum Prospects in the Energy Crisis. 1975.

Argentina has uranium reserves in several areas, the most important are in Mendoza Province. There were 20 areas throughout the country that had uranium mines, and 50 deposits had important reserves.

CNEA controlled all production of atomic energy as well as the mining of uranium ore. This Government agency was considering the possibility of subcontracting with foreign companies for uranium exploration.

CNEA continued construction of the second 600-megawatt Candú atomic power center in Río Tercero, Córdoba Province. The project, delayed 1 year, was expected to be completed by 1981. Three other atomic centers for Argentina were under study, but at yearend only two proposed centers were active: Bahía Blanca and Atucha No. 2, next to Atucha No. 1 (the 319-megawatt center located 95 kilometers northwest of Buenos Aires and initiated in 1973). The capacity of Atucha No. 2 would be 685 megawatts, and work was to begin in 1979.

Argentina was in the process of developing and integrating its operations, from the mining of uranium to the production of nuclear pellets, under a plan to complete the entire cycle by 1979. A decision was made to set up a 30-ton pilotplant for the production of heavy water at Arroyito, Neuquén Province.

The Mineral Industry of Australia

By Charlie Wyche [1]

Recovery from the worldwide economic recession of recent years was gradual, and some Australian mineral producers experienced difficulties in maintaining production levels and profitability. World demand for many minerals and metals continued to be weak, and the Australian industry faced more competitive markets with the added burden of a high rate of inflation and incidence of labor problems. However, improvement began toward year-end 1976, and production records were set for bauxite, alumina, black coal, manganese, and nickel.

The value of mine production of all minerals in Australia increased to $4.1 billion,[2] 21% higher than the $3.4 billion reported for 1975. The $4.3 billion value added by domestic smelting and other processing of mineral commodities credited the mineral industry with products valued at $8.4 billion. This figure represents 9.5% of the $88.2 billion adjusted gross national product (GNP).

In its first full year in office, the Federal Government (elected in December 1975) made a number of decisions of direct or indirect interest to the mining industry. These included relaxation of restrictions on the amount of equity that foreign mining companies could hold, provision for an investment allowance, and phasing out the export coal levy. Petroleum exploration expenditures became immediately deductible against income from any source instead of petroleum income only. All production of crude oil from new discoveries would be free from the $2-per-barrel production excise. Mineral export control procedures were greatly simplified. Instead of ship-by-ship approvals, exporters were able to secure approval of all shipments under a contract over an extended period, usually 1 year. Devaluation of the Australian dollar in November was advantageous to exporters and helped some major mining companies to record substantial profits during the second half of the year. A less welcome decision was removal of the total tax exemption on profits from gold mining. The withdrawal of export licenses for rutile and zircon recovered from sand mining operations on Fraser Island, Queensland, was also unfavorable. These deposits were worked on leases granted by the Queensland government, but by denying access to markets the Federal Government exercised a form of veto over the mining operations. This form of control was always available, but the Fraser Island case was believed to be the first time in which it was used retrospectively to close a mining concern.

The Government still placed emphasis on the objective of achieving 50% Australian ownership and control of mining ventures. It was expected that this would be achieved prior to mineral production. The Government announced, however, that a lack of Australian investors would not prevent mineral development.

There were strong indications of a revival in domestic mineral exploration and development. Local and overseas companies demonstrated confidence in the future of mining in Australia by their commitment to large capital expenditures on exploration and development projects. Coal, iron ore, aluminum, nickel, uranium, and some base metal projects were either

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Australian dollars ($A) to U.S. dollars at the rate of $A1.00=US$1.17.

being developed or under investigation. In 1976, it was estimated that total capital required for all active and deferred projects was in excess of $14.4 billion.

PRODUCTION

Production of most major commodities increased quantitatively, with the exception of iron ore, copper, lead, and zinc. However, the corresponding value increases were, almost without exception, substantially greater because of renegotiation of contract prices and higher prices on domestic and world markets. The major contributors to the increase in mine value were black coal, iron ore, mineral sands, zinc, nickel, liquefied petroleum gases (LPG), and some nonmetals.

Production of phosphate rock from newly developed deposits continued to increase; output of mineral sands increased with commencement of new production; and mine production of tin was up after a steady decline for several years. Exceptions to the upward trend were iron ore production, which declined for the first time in recent years, reflecting world market conditions, and mine production of lead and zinc, because of a rundown of stocks and the closure of a mine. The number of gold mines continued to decrease, and gold output declined.

Western Australia remained the largest mineral-producing State, accounting for 37% of the total national mineral output value in 1976. The value of minerals produced was $1.5 billion, an 83% increase over the previous year's total. Principal reasons for the value rise were increased production of alumina, nickel, ilmenite, and rutile, and the higher price paid by Japanese steel mills for iron ore. Iron ore production decreased 1.5 million tons to 85.5 million tons, but the value increased from $750 million to $841 million. The value of nickel concentrate increased $45 million to $222.8 million, and the values of rutile and ilmenite increased $11.5 million and $2.1 million, respectively. The increase by these minerals more than offset the decline in value of alumina, gold, and zircon.

Queensland was the second largest mineral-producing State, with a mineral value of $1.1 billion. This figure represents an increase of $375 million over that of 1975, and is 27% of total national output. This was due mainly to increased coal production and increased prices for the major metals. The total value of coal was $629.1 million, with 25.8 million tons mined. The second highest earner was copper, with a total value of $180 million for 159,000 tons mined. Other major minerals mined in Queensland were zinc ($68.1 million), bauxite ($62.7 million), and lead ($49.2 million).

New South Wales, with its large base metal and coal industries, ranked third, accounting for 17% of total national value. Victoria, with substantial brown coal output, was fourth with 14%. Tasmania, South Australia, and the Northern Territory with a wide variety of minerals such as copper, tin, bauxite, and zinc contributed the remaining share.

Table 1.—Australia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum:			
Bauxite, gross weight ---thousand tons--	19,994	21,003	24,085
Alumina ---do---	4,899	5,129	6,206
Metal, refined ---do---	219	214	232
Antimony, mine output (content of antimony and lead concentrates)	1,406	2,205	2,213
Beryllium, beryl, gross weight	79	(1)	--
Bismuth, mine output, metal content	1,170	844	e 400
Cadmium:			
Mine output, metal content	1,443	1,613	1,522
Smelter output (refined)	720	549	650
Cobalt, mine output (content of zinc and nickel concentrates)	1,078	2,709	3,394
Columbium-tantalum concentrate, gross weight[2]	128	132	e 160
Copper:			
Mine output, metal content	251,340	218,961	214,292
Smelter:			
Primary	196,129	180,037	167,353
Secondary	3,641	4,230	3,033
Refined:			
Primary	162,461	165,770	160,741
Secondary	11,729	13,892	15,303
Gold:			
Mine output, metal content ---troy ounces--	512,611	526,821	497,693
Refined (excluding recovery from scrap) ---do---	415,869	481,682	471,844
Iron and steel:			
Iron ore, gross weight ---thousand tons--	96,950	97,651	93,248
Metal:			
Pig iron ---do---	7,250	7,475	7,418
Ferroalloys:[3]			
Ferrochromium, high-carbon	3,351	e 3,000	--
Ferromanganese, high-carbon	42,660	e 47,000	e 57,000
Ferrosilicon	8,982	e 9,000	e 9,000
Silicomanganese	21,573	e 16,000	e 11,000
Total	76,566	e 74,000	e 77,000
Crude steel ---thousand tons--	7,755	7,843	7,773
Steel semimanufactures[3] ---do---	6,820	5,914	NA
Lead:			
Mine output, metal content	375,304	407,801	399,369
Metal:			
Primary:			
Bullion, for export	144,203	151,520	161,100
Refined	192,757	159,793	181,941
Total	336,960	311,313	343,041
Secondary (excluding remelt)	e 32,000	e 30,000	31,600
Manganese ore, gross weight ---thousand tons--	1,522	1,555	2,154
Mercury ---76-pound flasks--	2	6	e 5
Molybdenum, mine output, metal content	3	e 3	e 5
Nickel:			
Mine output, metal content	45,981	75,825	83,145
Metal, refined e	20,000	34,000	48,000
Platinum-group metals:[e 4]			
Palladium, metal content ---troy ounces--	860	1,400	1,500
Platinum, metal content ---do---	260	r 430	470
Total ---do---	1,120	r 1,830	1,970
Rare-earth minerals: Monazite concentrate, gross weight	3,577	4,507	4,510
Selenium ---kilograms--	(5)	(5)	NA
Silver:			
Mine output, metal content ---thousand troy ounces--	21,539	23,348	25,074
Refined ---do---	8,246	8,972	7,551
Tin:			
Mine output, metal content	10,481	9,577	10,356
Refined:			
Primary	6,714	5,254	5,603
Secondary	475	396	255
Titanium concentrate, gross weight:			
Ilmenite	816,746	991,433	976,559
Leucoxene	14,782	16,871	e 17,000
Rutile	318,702	348,350	371,522
Tungsten, mine output, metal content	1,125	1,497	1,935
Zinc:			
Mine output, metal content	457,059	500,846	464,293
Smelter:			
Dust	7,227	NA	NA
Primary	276,831	193,310	246,636
Secondary	r 6,967	7,000	7,000
Zirconium concentrate, gross weight	367,772	382,217	411,271

See footnotes at end of table.

Table 1.—Australia: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS			
Abrasives, natural:			
Beach pebble	1,470	NA	NA
Garnet (sales)	83	NA	NA
Asbestos	30,863	47,922	55,056
Barite	7,466	23,460	10,500
Cement, hydraulic ---thousand tons	5,204	5,017	5,062
Clays:			
Bentonite and bentonitic clay	803	--	--
Brick clay and shale ---thousand tons	8,727	7,816	e 8,300
Cement clay and shale [6] ---do	375	NA	NA
Damourite clay (sales)	931	NA	NA
Fire clay [6] ---thousand tons	137	NA	NA
Fuller's earth	78	e 80	e 80
Kaolin and ball clay	98,152	e 100,000	e 100,000
Other [6] ---thousand tons	611	NA	NA
Diatomite	7,438	5,543	e 1,200
Feldspar	4,145	3,054	e 3,600
Fertilizer materials:			
Crude, phosphate rock	1,484	123,883	326,303
Manufactured, phosphatic (P_2O_5 content) ---thousand tons	5,352	1,593	e 2,700
Fluorspar	238	--	--
Gem stones ---value, thousands	r $57,019	$47,970	NA
Gypsum ---thousand tons	1,069	933	e 940
Lime [7]	941,548	e 950,000	e 950,000
Lithium minerals, petalite, gross weight	1	--	--
Magnesite	19,300	16,208	r 14,000
Perlite, crude	2,061	NA	NA
Pigments, natural mineral, ocher	38	NA	NA
Pyrite, including cupreous, gross weight	224,928	225,015	216,295
Salt [8] ---thousand tons	4,935	4,568	e 4,500
Sand and gravel:			
Construction sand ---do	24,520	NA	NA
Gravel ---do	17,500	NA	NA
Stone:			
Dolomite ---do	409	450	e 590
Limestone:			
For cement ---do	8,090	10,854	e 8,800
For other uses ---do	2,956		
Silica in the form of quartz, quartzite, and glass sand ---do	[6] 1,443	NA	NA
Other:			
Crushed and broken ---do	54,671	NA	NA
Dimension [9] ---do	143	NA	NA
Unspecified [10] ---do	33,656	NA	NA
Sulfur:			
Byproduct [11] ---do	411	441	e 420
Sulfuric acid (from source materials) ---do	2,431	1,151	e 1,500
Talc, soapstone, pyrophyllite	79,837	82,387	e 93,000
MINERAL FUELS AND RELATED MATERIALS			
Coal:			
Bituminous and subbituminous ---thousand tons	63,033	67,019	74,881
Lignite ---do	27,303	28,178	30,939
Total ---do	90,336	95,197	105,820
Coke:			
Metallurgical ---do	5,114	5,239	5,310
Gashouse (including breeze) ---do	65	e 65	e 65
Total ---do	5,179	5,304	5,375
Fuel briquets	1,155	1,030	959
Gas, natural, marketed production ---million cubic feet	r 159,339	177,491	209,380
Natural gas liquids [e] ---thousand 42-gallon barrels	17,300	r 19,300	22,700
Petroleum:			
Crude ---do	140,911	149,880	152,528
Refinery products:			
Gasoline:			
Aviation ---do	440	252	297
Other ---do	76,283	78,220	79,960
Jet fuel ---do	13,284	13,844	13,186
Kerosine ---do	1,365	1,233	2,066
Distillate fuel oil ---do	45,633	50,545	51,891
Residual fuel oil ---do	33,040	29,820	30,704
Lubricants ---do	2,705	2,440	3,358
Other:			
Refinery gas [12] ---do	793	742	727
Liquefied petroleum gas ---do	3,919	4,082	4,071

See footnotes at end of table.

Table 1.—Australia: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
MINERAL FUELS AND RELATED MATERIALS—Continued				
Petroleum—Continued				
Refinery products—Continued				
Other—Continued				
Solvents	thousand 42-gallon barrels	1,824	1,258	1,455
Bitumen	do	2,900	2,830	2,911
Unspecified	do	8,542	8,680	8,389
Refinery fuel and losses	do	15,844	15,234	16,467
Total	do	206,572	209,180	215,482

e Estimate. p Preliminary. r Revised. NA Not available.

1 Revised to none.

2 Exports (production not officially reported).

3 Data for plants owned by Broken Hill Pty. Co. Ltd. (BHP) are for years ending November 30 of that stated.

4 Figures represent recovery from nickel concentrate exported to Japan from Kambalda.

5 The output of Peko-Wallsend Ltd. reported in the previous edition of this chapter as Australian output has been deleted because it represented the content of intermediate products of metallurgical operations which are treated elsewhere to recover elemental selenium. Australia has one metallurgical facility that can recover selenium (the Port Kembla refinery of the Electrolytic Refining and Smelting Co. of Australia Ltd.) but output, if any, at this facility is not reported and no basis is available for estimation.

6 Excludes producion from Western Australia.

7 Data are for years ending June 30 of that stated.

8 Excludes production from Victoria.

9 Excludes production from Northern Territory, Australian Capital Territory, and Queensland.

10 Excludes production from Northern Territory, Australian Capital Territory, and Western Australia.

11 Sulfur content of materials obtained as a byproduct of nonferrous metallurgical operations and oil refining.

12 Residual fuel oil equivalent.

TRADE

Increased exports of most major minerals and higher prices caused export income from minerals and mineral products to reach a record high. The value of exports of primary products was $4 billion, an increase of 29%. Exports of most of the more important mineral commodities increased in 1976, except for refined aluminum exports, whose value was down slightly; exports of alumina and coal were at record high levels. The value of coal exports, among the largest earners of foreign exchange, increased 47% to $1.1 billion, that of iron ore and pellets 11% to $828 million, and that of alumina 53% to $527 million. Significant gains in exports were also reported for nickel concentrate (from $176 million to $278 million), lead (from $130 million to $161 million), and zinc (from $118 million to $160 million).

The value of mineral imports increased 14% to $723 million. Crude oil accounted for approximately 78% of this. Phosphate rock, asbestos, and diamond (gem), with values of $53 million, $22 million, and $20 million, respectively, were the other principal import categories.

Table 2.—Australia: Exports and reexports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal destinations, 1974–75
METALS			
Aluminum:			
Bauxite, gross weight[2]	7,936	7,900	Japan 2,940; West Germany 2,758; Italy 1,465.
Alumina, gross weight ---thousand tons--	3,881	[3] 4,503	United States 1,954; Canada 388.
Metal:			
Scrap	1,204	1,721	Japan 943; Netherlands 189; United States 181.
Unwrought	r 46,492	64,065	Indonesia 52,317.
Semimanufactures	r 6,060	6,128	New Zealand 2,231; Papua New Guinea 481; Singapore 473.
Beryllium ore and concentrate, gross weight	105	99	All to Japan.
Cadmium metal, refined, unwrought and semimanufactures	513	430	United States 174; United Kingdom 167.
Chromium:			
Chromite ore and concentrate, gross weight	187	44	New Zealand 23; Singapore 20.
Chromium oxides and hydroxides	26	30	Republic of South Africa 20; New Zealand 5.
Columbium and tantalum, columbite-tantalite concentrate, gross weight	141	123	Japan 41; United States 34; Netherlands 28.
Copper:			
Ore and concentrate, gross weight	175,136	146,970	Japan 133,842; Republic of Korea 5,134.
Matte	5,113	5,849	All to Netherlands.
Metal including alloys:			
Copper-lead dross and speiss	1,410	4,681	All to United States.
Copper slags and residues	288	6,778	Singapore 6,553.
Scrap including alloy scrap	311	432	United Kingdom 150; Japan 117; Pakistan 90.
Unwrought:			
Blister and cement	10,426	15,136	All to Japan.
Other, unalloyed	50,678	93,862	West Germany 42,305; United Kingdom 20,719.
Alloyed	25	12	New Zealand 7; Papua New Guinea 3.
Semimanufactures:			
Unalloyed	19,990	16,986	New Zealand 8,337; Malaysia 1,728.
Alloyed	4,907	2,006	Hong Kong 592; New Zealand 432; Singapore 315.
Gold:			
Ore and concentrate, metal content[4] troy ounces--	r 143,907	160,207	NA.
Metal:			
Mint bullion ---do---	72,388	57,202	United Kingdom 31,676; Hong Kong 15,396.
Refined and unrefined bullion -do---	83,370	95,842	United Kingdom 88,066.
Iron and steel:			
Ore and concentrate ---thousand tons--	r 78,290	85,316	Japan 64,144; West Germany 5,085.
Metal:			
Scrap ---do---	575	733	NA.
Pig iron and equivalent materials do---	935	559	People's Republic of China 324; Japan 148.
Ferroalloys	682	1,158	Philippines 536; New Zealand 377.
Steel ingots and other primary forms thousand tons--	808	1,162	West Germany 242; Argentina 214; Brazil 110.
Semimanufactures:			
Bars, rods, angles, shapes, sections do---	112	162	New Zealand 74; People's Republic of China 20; United States 20.
Universals, plates, sheets -do---	r 221	259	New Zealand 63; United States 20; People's Republic of China 19.
Hoop and strip ---do---	8	15	New Zealand 8; United Kingdom 5.
Rails and accessories ---do---	11	4	Fiji 2; Indonesia 1.
Wire ---do---	21	22	New Zealand 11; United States 5; Papua New Guinea 3.

See footnotes at end of table.

Table 2.—Australia: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal destinations, 1974–75
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures—Continued			
Tubes, pipes, fittings, thousand tons	69	112	Singapore 12; New Zealand 10; United States 7.
Casting and forgings, rough, do	5	10	Papua New Guinea 8; Singapore 1.
Total, do	r 447	584	
Lead:			
Ore and concentrate, gross weight	77,678	42,192	United States 31,372; United Kingdom 5,836; Japan 4,984.
Slag and residue	36,072	25,372	United States 17,717; Japan 2,778.
Oxides	3,547	2,811	Malaysia 1,197; Thailand 470; Singapore 295.
Metal including alloys:			
Scrap including alloy scrap	937	397	West Germany 188; Republic of South Africa 83.
Unwrought:			
Lead-silver bullion, lead content	147,820	152,703	United Kingdom 125,900; Netherlands 11,959.
Refined	134,158	124,757	United Kingdom 46,893; India 26,496; Iran 15,216.
Alloys, antimonial and other	r 6,361	4,757	New Zealand 1,948; Singapore 992; Malaysia 606.
Semimanufactures	1,588	605	Malaysia 144; New Zealand 95; Singapore 79.
Magnesium oxide	108	323	United States 92; New Zealand 83; Netherlands 71.
Manganese ore, gross weight	71,922	65,000	All to New Zealand.
Nickel metal and alloys: [5]			
Unwrought, value, thousands	r $44,455	$66,631	NA.
Semimanufactures, do	r $19,810	$32,803	NA.
Platinum-group metals, troy ounces	26,640	23,013	Hong Kong 9,060; New Zealand 5,378; United Kingdom 4,541.
Rare-earth metals:			
Monazite concentrate, gross weight	3,772	3,684	France 1,570; United Kingdom 960; West Germany 880.
Silver:			
Concentrate and lead-silver bullion, silver content [4], thousand troy ounces	13,037	14,343	NA.
Mint buillion, do	3,225	4,355	Japan 2,187; United Kingdom 1,758.
Other, do	181	253	New Zealand 110; Singapore 61; Hong Kong 50.
Tin:			
Ore and concentrate, gross weight	8,641	13,371	Malaysia 6,796; United Kingdom 6,094.
Oxides	17	28	Japan 15; New Zealand 7; Malaysia 5.
Metal including alloys:			
Unwrought	2,821	2,434	United Kingdom 1,502; New Zealand 332; Netherlands 251.
Semimanufactures	582	548	New Zealand 252; Papua New Guinea 133; Singapore 94.
Titanium ore and concentrate, gross weight:			
Ilmenite (excluding beneficiated ilmenite)	710,670	628,422	United Kingdom 149,506; Japan 114,491; France 112,432.
Leucoxene	16,618	15,824	United States 14,803.
Rutile	354,126	338,037	United States 167,142; United Kingdom 54,119.
Tungsten ore and concentrate, gross weight:			
Scheelite	1,617	1,914	West Germany 1,103; France 220.
Wolframite	368	465	Japan 144; West Germany 115; United Kingdom 74.
Uranium and thorium ores and concentrates, excluding monazite	15	--	
Vanadium ore and concentrate	418	10,541	Japan 8,151; United States 2,386.

See footnotes at end of table.

Table 2.—Australia: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal destinations, 1974–75
METALS—Continued			
Zinc:			
Ore and concentrate, gross weight	426,178	403,822	Japan 177,014; Netherlands 91,398; Belgium-Luxembourg 57,291.
Oxide	1,940	1,318	Indonesia 568; Sri Lanka 206; Philippines 195.
Metal including alloys:			
Slag and residues	6,613	5,536	Republic of South Africa 3,552; France 641.
Unwrought	164,778	140,429	United States 31,180; United Kingdom 20,347; New Zealand 19,569.
Semimanufactures	2,439	2,856	New Zealand 1,160; United States 498; Malaysia 455.
Zirconium ore and concentrate, gross weight, minimum 30% $ZrSiO_4$	400,427	388,964	Japan 155,636; United States 54,980.
Other:			
Ores and concentrates of base metals, n.e.s value, thousands	r $78,843	$118,937	NA.
Waste and scrap containing nonferrous metals	15,489	18,486	Singapore 13,803; Japan 3,577.
Oxides, hydroxides, peroxides of metals, n.e.s value, thousands	r $4,508	$2,443	Philippines $281; India $259; Malaysia $242.
Metals including alloys, all forms:			
Unwrought and semimanufactures:			
Magnesium and beryllium and their alloys	59	345	Indonesia 144; New Zealand 87.
Base metals including alloys, all forms value, thousands	r $272	$1,069	Nauru $604; United Kingdom $228.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc do	r $150	$172	Japan $84; Singapore $39; New Zealand $17.
Dust and powder of precious and semiprecious stones do	$50	$107	United States $34; Philippines $23; Italy $14.
Grinding and polishing wheels and stones do	r $507	$864	New Zealand $380; Philippines $128; Malaysia $107.
Asbestos, crude and fiber	29,372	15,940	Japan 10,357; New Zealand 1,411; Malaysia 1,331.
Barite and witherite	1,079	2,690	New Zealand 2,459.
Cement, hydraulic	112,779	146,614	Singapore 130,431.
Clays and clay products (including all refractory brick):			
Crude clays including fire clay and sillimanite	6,043	7,464	United Kingdom 5,316; Japan 1,355.
Products:			
Refractory:			
Bricks	3,193	7,458	New Zealand 4,956; Malaysia 647.
Other value, thousands	r $679	$931	New Caledonia $199; New Zealand $183; Singapore $149.
Nonrefractory do	r $319	$273	Papua New Guinea $76; New Zealand $70.
Diamond:			
Gem, not set or strung carats	7,178	6,095	Hong Kong 1,382; Belgium-Luxembourg 1,324; Israel 878.
Industrial do	160,695	216,267	Ireland 147,817; United States 35,200; Philippines 25,127.
Fertilizer materials:			
Crude, nitrogenous	69	18,016	Republic of Korea 6,602; Malaysia 5,358.
Manufactured:			
Nitrogenous	r 37,869	7,291	Philippines 5,948; New Zealand 780.
Phosphatic (excluding basic slag)	70	918	Papua New Guinea 340; Malaysia 252; New Caledonia 250.
Potassic	15	34	Malaysia 30; New Zealand 4.
Other, including mixed	1,453	20,319	Indonesia 20,255; Papua New Guinea 36.

See footnotes at end of table.

Table 2.—Australia: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal destinations, 1974–75
NONMETALS—Continued			
Fertilizer materials—Continued			
Ammonia ---value, thousands--	r $6,197	$15,803	United States $13,904.
Gem stones, except diamond:			
Opal ---do---	r $21,788	$19,072	Hong Kong $10,009; United States $2,982.
Sapphire ---do---	r $4,250	$3,261	Thailand $1,078; New Zealand $417; Hong Kong $410.
Other ---do---	r $1,620	$1,679	Hong Kong $410; New Zealand $381; United States $283.
Gypsum	390,028	264,891	New Zealand 163,692; Singapore 29,327.
Lime (quicklime, slaked lime, hydraulic lime)	5,123	2,267	Papua New Guinea 2,068.
Magnesite	975	644	All to United States.
Mica, worked, and articles -value, thousands--	$65	$62	New Zealand $59.
Pigments, mineral:			
Micaceous iron oxide	51	26	New Zealand 8; Hong Kong 7; Malaysia 5.
Iron oxides, other	67	116	Canada 59; New Zealand 41; Papua New Guinea 11.
Pyrite, unroasted, gross weight	109	15	Papua New Guinea 10; New Zealand 5.
Salt and brine ---thousand tons--	4,063	3,898	Japan 3,322; Taiwan 368.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	785	8,364	New Zealand 5,645; Poland 1,500.
Caustic potash	62	104	New Zealand 102.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	2,347	379	Japan 359.
Worked ---value, thousands--	$46	$40	United States $21; Nauru $6; Fiji $4.
Sand and gravel, limestone, flux, other calcareous stone	554,536	513,856	Japan 460,142; United States 38,354.
Sulfur, sulfuric acid	14,088	6,101	Japan 5,879.
Talc, steatite, soapstone, pyrophyllite	47,601	43,801	Japan 24,049; Netherlands 17,991.
Other nonmetals:			
Crude:			
Quartz, mica, feldspar, fluorspar, cryolite	1,539	248	New Zealand 148; West Germany 89.
Refractory materials, except clay and magnesite	48	173	Indonesia 95; New Zealand 57.
Other ---value, thousands--	r $116	$85	United States $30; New Zealand $15; Papua New Guinea $14.
Oxides and hydroxides of magnesium, strontium, barium	666	306	Philippines 212; Mauritania 65.
Building materials of asphalt, asbestos, and fiber cement ---value, thousands--	r $3,286	$9,887	New Zealand $2,572; Papua New Guinea $1,578; Canada $1,297.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	22,941	21,180	New Zealand 7,179; Indonesia 5,338; Malaysia 3,862.
Coal, bituminous and lignite, and peat (including briquets):			
Bituminous coal and briquets thousand tons--	27,853	32,657	Japan 24,324.
Lignite, peat, and briquets thereof	2	40	Malaysia 25; Papua New Guinea 3.
Coke and semicoke ---thousand tons--	141	421	Japan 192; Netherlands 131; Belgium-Luxembourg 48.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels--	1,918	1,474	Japan 901; New Zealand 573.
Refinery products:			
Gasoline ---do---	3,231	2,463	New Zealand 2,086; Fiji 269.
Jet fuel ---do---	1,928	2,533	New Zealand 1,571; Fiji 484; Singapore 271.
Kerosine ---do---	480	635	New Zealand 608; Papua New Guinea 8.
Distillate fuel oil ---do---	4,653	2,805	New Zealand 1,732; Singapore 512; Fiji 456.

See footnotes at end of table.

Table 2.—Australia: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal destinations, 1974–75
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum—Continued			
Refinery products—Continued			
Residual fuel oil thousand 42-gallon barrels	3,189	3,322	Japan 1,596; United Kingdom 781.
Lubricants ---do---	682	730	New Zealand 292; Kenya 135; Malaysia 68.
Other ---do---	r 360	297	Mainly to New Zealand.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals value, thousands	r $3,303	$2,685	New Zealand $1,300; West Germany $858.

r Revised. NA Not available.
[1] Data are for years beginning July 1 of that stated, unless otherwise specified.
[2] Data for 1973–74 and 1974–75 are from import statistics of trading partner countries for calendar years 1974 and 1975, respectively.
[3] Destinations are from import statistics of trading partner countries for calendar year 1975.
[4] Australian Mineral Industry, Quarterly Review—Quarterly Statistics. Bureau of Mineral Resources, Geology and Geophysics. V. 29, No. 1, 1977. Data are for years beginning March 1 of that stated.
[5] In addition to forms of nickel listed, Australia also exported nickel ore and concentrate, but neither quantity nor value is published in a form that is separable from other commodities.

Table 3.—Australia: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal sources, 1974–75
METALS			
Aluminum:			
Oxide and hydroxide	4,708	9,275	Japan 4,109; France 1,529; United States 1,401.
Metal including alloys:			
Scrap	2,940	1,211	New Zealand 1,060; Japan 100.
Unwrought	9,083	2,847	United States 738; Japan 680; Taiwan 601.
Semimanufactures	8,122	9,414	United States 3,969; United Kingdom 1,770.
Antimony metal, all forms	125	203	People's Republic of China 135; Belgium-Luxembourg 25.
Arsenic trioxide and pentoxide	1,315	1,402	France 734; United Kingdom 401; Territory of South-West Africa 193.
Beryllium metal including alloys, all forms value	r $5,502	$1,430	All from United States.
Bismuth metal including alloys, all forms	14	17	United Kingdom 6; West Germany 3; Japan 3.
Cadmium metal including alloys, all forms	10	9	United States 4; Republic of Korea 2; Mexico 2.
Chromium:			
Chromite	8,270	39,773	Philippines 27,701; Iran 10,668.
Oxide, hydroxide, trioxide	1,585	879	United States 320; U.S.S.R. 291; West Germany 243.
Metal including alloys, all forms	45	28	United Kingdom 16; Japan 12.
Cobalt:			
Oxide and hydroxide	38	71	United States 52; United Kingdom 10.
Metal including alloys, all forms	198	41	United Kingdom 11; Zaire 11.
Copper:			
Ore and concentrate ---kilograms---	NA	57	Mainly from Republic of South Africa.
Copper sulfate	2,575	1,090	New Zealand 956.
Metal including alloys:			
Scrap:			
Unalloyed	1,143	686	New Zealand 319; Malaysia 173; Papua New Guinea 102.
Alloyed	1,106	2,674	Papua New Guinea 2,332; New Zealand 188.
Unwrought	1,552	258	Japan 101; United States 60.
Semimanufactures [2]	20,601	20,717	Japan 14,255; United Kingdom 5,444.

See footnotes at end of table.

Table 3.—Australia: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal sources, 1974–75
METALS—Continued			
Gold:			
Ore and concentrate	16	45	All from Fiji.
Crude bullion, gold content troy ounces	89,830	84,795	Fiji 60,645; Papua New Guinea 24,107.
Refined bullion do	660	1,252	Hong Kong 932; New Zealand 320.
Iron and steel:			
Ore and concentrate, including roasted pyrite	13,964	18,378	Canada 11,844; Philippines 6,501.
Metal:			
Scrap	114	492	Papua New Guinea 271; United States 171.
Sponge iron, powder, shot	7,265	8,702	Sweden 3,670; Japan 1,894.
Spiegeleisen	30	24	All from West Germany.
Ferroalloys:			
Powder:			
Ferromanganese	374	325	Japan 249; West Germany 37; Belgium-Luxembourg 36.
Other	1,186	463	United Kingdom 272; Japan 146.
Shot:			
Ferrochromium	14,646	9,390	Republic of South Africa 3,247; India 1,806.
Ferromanganese	12,196	7,239	Republic of South Africa 6,514.
Ferromolyodenum	253	540	Austria 245; United States 185.
Ferrosilicon	14,286	21,578	Republic of South Africa 9,415; Japan 3,306.
Ferronickel	1,450	1,563	New Caledonia 1,562.
Other	3,324	--	
Steel, primary forms	212,494	136,440	Japan 133,807.
Semimanufactures:			
Bars, rods, angles, shapes, sections	60,462	91,236	Japan 57,928.
Universals, plates, sheets	371,196	288,701	Japan 217,652; United States 32,332.
Hoop and strip	r 49,447	40,767	Japan 23,438; United Kingdom 5,215.
Rails and accessories	15,925	19,230	Japan 18,726.
Wire	45,483	63,967	Italy 34,744; Japan 20,450.
Tubes, pipes, fittings [3]	r 239,335	90,335	Japan 63,478.
Castings and forgings, rough value, thousands	r $220	$204	United States $109; West Germany $43.
Lead:			
Oxides	33	91	United Kingdom 65; Republic of South Africa 20.
Metal including alloys:			
Scrap	326	160	New Zealand 85; Fiji 36.
Unwrought and semimanufactures	98	119	New Zealand 65; United Kingdom 28.
Magnesium metal including alloys, all forms	2,544	2,749	U.S.S.R. 1,202; Norway 1,019.
Manganese:			
Ore and concentrate:			
Battery grade	299	2,581	All from United States.
Metallurgical grade	1,606	171	Do.
Oxides	1,087	1,396	United States 805; Japan 560.
Metal including alloys, all forms	950	1,197	Republic of South Africa 1,105.
Mercury 76-pound flasks	2,974	1,456	People's Republic of China 831; Spain 287.
Molybdenum:			
Ore and concentrate	469	642	Canada 296; Chile 163; United States 149.
Metal including alloys, all forms:			
Wire	8	6	Mainly from United States.
Other value, thousands	r $87	$84	United States $52; United Kingdom $18.
Nickel:			
Matte, speiss, similar materials	177,362	--	
Metal including alloys:			
Scrap	5	16	United States 11; New Zealand 4.
Unwrought	2,496	2,191	Canada 2,134.
Semimanufactures	1,344	2,023	United States 1,201; United Kingdom 385.

See footnotes at end of table.

Table 3.—Australia: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal sources, 1974–75
METALS—Continued			
Platinum-group metals and silver:			
Ores and concentrates	23	8	All from Fiji.
Waste and sweepings—value, thousands	r $385	$1,132	New Zealand $851; Hong Kong $187.
Metals including alloys:			
Platinum-group ——— troy ounces	1,392,796	20,885	United States 8,442; United Kingdom 7,242.
Silver containing 75% or more silver, silver content ———do	99,047	38,053	Fiji 21,601; Hong Kong 10,353.
Silicon metal	2,496	2,602	Norway 751; France 583; Switzerland 380.
Tin:			
Oxides	9	5	United Kingdom 3; West Germany 2.
Metal including alloys:			
Scrap	4	(4)	All from Australia (reimported).
Unwrought	67	27	Mainly from Malaysia.
Semimanufactures	1,134	42	United States 24; West Germany 10.
Tungsten:			
Ore and concentrate	(4)	--	
Metal including alloys, all forms	14	12	United States 6; West Germany 2.
Zinc:			
Ore and concentrate	21,935	6,468	Canada 5,576; New Zealand 692.
Oxides	1,574	1,141	United States 563; Canada 288; United Kingdom 197.
Metal including alloys, all forms	119	69	United States 34; New Zealand 16.
Other:			
Ores and concentrates:			
Of niobium, tantalum, titanium, vanadium, zirconium	60	11	NA.
Of base metals, n.e.s	12,048	4,726	United States 3,766; Republic of South Africa 917.
Ash and residue containing nonferrous metals	12,829	7,683	Chile 6,700; New Zealand 601.
Oxides, hydroxides, peroxides of metals, n.e.s	r 1,236	1,854	United States 1,106; Japan 135.
Metals including alloys, all forms:			
Metalloids	2,820	2,668	Canada 1,106; United States 720.
Alkali, alkaline earth, rare-earth metals	70	87	West Germany 39; United States 25.
Base metals including alloys, all forms, n.e.s	429	407	United States 240; Republic of South Africa 54.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	1,396	935	United States 514; New Zealand 130; Greece 107.
Grinding and polishing wheels and stones	1,301	1,319	United Kingdom 295; West Germany 189; Japan 175.
Asbestos:			
Chrysotile	40,165	30,800	Canada 27,671.
Amosite	10,070	11,546	Republic of South Africa 8,507; Canada 3,007.
Other	6,816	8,658	Canada 7,314; West Germany 888.
Barite and witherite, natural and ground	9,532	1,400	All from People's Republic of China.
Boron materials:			
Crude natural borates	1,075	913	Japan 663; United Kingdom 123; Turkey 100.
Oxide and acid	3,090	3,397	United States 3,210.
Cement, hydraulic	48,811	36,839	Japan 19,588; United Kingdom 5,988.
Chalk	9,589	10,074	United Kingdom 5,902; France 4,121.

See footnotes at end of table.

Table 3.—Australia: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal sources, 1974–75
NONMETALS—Continued			
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Bentonite	69,054	50,215	United States 45,079.
Fire clay and ball clay	r 4,370	4,770	United States 3,293; United Kingdom 1,265.
Andalusite, mullite, chamotte, dinas earths	14,513	2,010	United States 1,383; India 554.
Kyanite and sillimanite	737	--	
White clays	33,592	--	
Other	20,375	31,526	United States 30,131.
Products:			
Refractory (including nonclay bricks)	15,684	34,597	United Kingdom 12,232; Japan 8,615; Austria 6,131.
Nonrefractory ----value, thousands--	r $31,986	$24,205	Italy $6,040; United Kingdom $2,442; West Germany $1,880.
Cryolite and chiolite	506	193	Denmark 175.
Diamond:			
Gem, not set or strung ----------carats--	198,213	89,501	Israel 43,756; Belgium-Luxembourg 20,973.
Industrial, including dust --------do----	1,089,969	923,761	Republic of South Africa 289,070; United States 233,355.
Diatomite and other infusorial earth	8,159	9,895	United States 8,546.
Feldspar, leucite, nepheline	13,653	6,166	Canada 2,799; People's Republic of China 2,450.
Fertilizer materials:			
Crude:			
Nitrogenous	3,920	3,135	Chile 3,008.
Phosphatic ----------thousand tons--	3,109	2,647	Nauru 1,278; Christmas Island 1,002.
Manufactured:			
Nitrogenous	6,535	12,288	Japan 6,313; France 2,740; West Germany 2,200.
Phosphatic	1,816	332	Japan 321.
Potassic	182,881	211,109	United States 138,232; Canada 71,432.
Other, including mixed	5,201	4,767	West Germany 3,179; United States 654.
Ammonia ----------value, thousands--	r $394	$1,889	United States $1,886.
Fluorspar	30,332	30,627	Republic of South Africa 15,369; Thailand 7,722.
Graphite, natural	2,180	1,269	Sri Lanka 555; Republic of Korea 336; People's Republic of China 189.
Gypsum and plasters	918	904	United Kingdom 559; United States 226.
Iodine	54	47	Japan 34; United States 12.
Lime ----------value, thousands--	r $31	$37	United Kingdom $21; United States $8.
Magnesite, crude, calcined, fused	742	174	United States 58; People's Republic of China 50.
Mica:			
Crude, including splittings and waste ---	1,188	888	India 391; Republic of South Africa 263.
Worked, including agglomerated splittings value, thousands--	r $327	$410	West Germany $96; United States $95.
Pigments, mineral:			
Natural, crude	1,004	792	Austria 368; United Kingdom 172.
Iron oxides, processed	11,940	9,448	West Germany 6,778; Spain 790; United Kingdom 561.
Precious and semiprecious stones, except diamond:			
Natural ----------value, thousands--	r $6,256	$6,011	Thailand $1,461; India $754; West Germany $598.
Manufactured ---------- do----	r $421	$468	Austria $124; Switzerland $100; Hong Kong $56.
Salt	5,441	44,434	United Kingdom 42,192.
Sodium and potassium compounds, n.e.s.:			
Caustic soda ----------value, thousands--	r $22,664	$52,301	NA.
Caustic potash, sodic and potassic peroxides	r 2,171	2,777	Japan 1,188; West Germany 600.

See footnotes at end of table.

Table 3.—Australia: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal sources, 1974–75
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	3,455	3,835	Mainly from Italy.
Slate	464	741	Republic of South Africa 560; Italy 99.
Other	1,267	1,610	Republic of South Africa 632; Finland 595.
Worked—value, thousands	r $1,228	$1,329	Italy $825; United Kingdom $117.
Dolomite	450	416	West Germany 222; United States 178.
Gravel and crushed rock	419	411	New Zealand 104; France 95; Belgium-Luxembourg 92.
Limestone (except dimension)	1,370,343	1,591,609	All from Japan.
Quartz and quartzite	846	1,121	Sweden 799; West Germany 163; United States 113.
Sand, excluding metal bearing	827	1,182	Sweden 500; Republic of South Africa 212; New Zealand 184.
Sulfur:			
Elemental:			
Other than colloidal	608,092	580,183	Mainly from Canada.
Colloidal	115	54	United States 26; West Germany 14; France 13.
Sulfur dioxide	351	369	United States 148; Japan 139.
Sulfuric acid, oleum	5	620	Mainly from Japan.
Talc, steatite, soapstone, pyrophyllite	1,700	1,062	People's Republic of China 601; United States 312.
Vermiculite	3,215	3,639	Republic of South Africa 2,781; People's Republic of China 749.
Other nonmetals:			
Crude	1,439	936	Italy 341; United States 254; West Germany 132.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture	9	91	Mainly from New Zealand.
Slag and ash, n.e.s	--	17	Mainly from United States.
Oxides and hydroxides:			
Magnesium	13,592	21,376	Japan 20,684; United States 498.
Strontium and barium	2,848	5,040	Japan 4,816; United States 179.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s—value, thousands	r $247	$9,887	New Zealand $2,677; Canada $1,350.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,089	925	United States 430; Trinidad and Tobago 428.
Carbon black	2,402	2,167	United States 1,245; Canada 557.
Coal, all types, including briquets	8,140	14,230	Republic of South Africa 14,084.
Coke and semicoke	2,524	17,037	United Kingdom 10,080; United States 3,752.
Peat	4,340	5,441	West Germany 4,661; Finland 509.
Petroleum:			
Crude and partly refined—thousand 42-gallon barrels	64,201	60,276	Saudi Arabia 21,702; Kuwait 14,409.
Refinery products:			
Gasoline—do	2,667	2,646	Bahrain 860; People's Democratic Republic of Yemen 719.
Jet fuel—do	300	187	Singapore 69; Bahrain 49; Iran 37.
Kerosine—do	638	604	People's Democratic Republic of Yemen 376; Bolivia 114.
Distillate fuel oil—do	3,364	3,985	Singapore 2,602; Bahrain 849.
Residual fuel oil—do	18,426	14,906	Singapore 6,228; Bahrain 3,847.
Lubricants—do	r 320	565	United States 216.
Other:			
Liquefied petroleum gas—do	2	1	Mainly from United States and France.

See footnotes at end of table.

Table 3.—Australia: Imports of mineral commodities[1]—Continued
(Metric tons unless otherwise specified)

Commodity	1973–74	1974–75	Principal sources, 1974–75
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum—Continued			
Refinery products—Continued			
Other—Continued			
Bitumen and other residues and bituminous mixtures, n.e.s thousand 42-gallon barrels	46	47	Singapore 37; United States 7.
Petroleum coke ----------do----	368	683	United States 675.
Unspecified ----------do----	r 3,613	3,492	Bahrain 2,753; United States 80.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals value, thousands	r $3,894	$4,612	United States $4,016; United Kingdom $267.

r Revised. NA Not available.
[1] Data are for years beginning July 1 of that stated.
[2] Partial figures; exclude quantities valued at $460,000 in 1974 and $546,000 in 1975.
[3] Partial figures; exclude quantities valued at $5,916,379 in 1974 and $12,620,495 in 1975.
[4] Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—Despite the slow pace of the general economic recovery, 1976 was a year of improvement for Australia's aluminum industry. Domestic production of bauxite, alumina, and aluminum increased significantly from the depressed level of 1975. The higher bauxite production resulted from increased output at the three main producing areas—Weipa, Queensland; Gove, Northern Territory; and the Darling Range, Western Australia. The greatest increase was in the Darling Range area, where a new mine began operating at Huntly, about 6 kilometers northeast of the Del Park mine. The combined output from these two mines supplied the increased bauxite requirement for the Pinjarra alumina refinery in Western Australia.

Alumina production increased 21% over that of 1975. The principal factor contributing to the higher total was the commissioning of increased capacity at the Pinjarra refinery. The total capacity of Alcoa of Australia Ltd.'s Pinjarra and Kwinana refineries was increased to 3.4 million tons annually. Output from Gladstone (Queensland) and Gove increased steadily throughout 1976, and by yearend both refineries were operating at installed capacity.

The increase in production of primary aluminum resulted from reactivation of idle capacity at the smelters of Comalco Industries Pty. Ltd. at Bell Bay, northern Tasmania, and of Alcan Australia Ltd. at Kurri Kurri, New South Wales. At yearend, the three domestic producers of primary aluminum (Alcan, Alcoa, and Comalco) were operating at full capacity.

At Weipa, on Cape York Peninsula, Comalco reported a record high bauxite production for 1976. Comalco, which is owned 45% by Conzinc Riotinto of Australia Ltd., 45% by Kaiser Aluminum & Chemical Corporation, and 10% by the Australian public, produced 9.6 million tons of bauxite. Shipments, however, were slightly lower than in the previous year at 9 million tons. The decline was owing mainly to the deferment of some shipments to Europe and to an industrial dispute at the Gladstone refinery. The company announced plans to develop a $280 million aluminum smelter at Gladstone. If the project proceeds as planned, Comalco could spend a total of $350 million over the next 4 years on the first stage of the smelter and expansion of its mining operations at Weipa.

The $9.8 million expansion program undertaken by Comalco at its Bell Bay aluminum operations was expected to be completed by July 1977. The project, which involves the construction of a fourth potline (reduction furnace), would raise the plant's total installed capacity 18,900 tons to 114,500 tons. The work underway

also included expanding the billet chill casting, homogenizing, and sawing facilities. The annual capacity of the $85 million complex, 48 kilometers north of Launceston, had been increased to 95,600 tons in five successive expansion programs since 1961. The Bell Bay complex uses alumina from Gladstone to produce primary metal, which goes to a number of fabricating and foundry outlets throughout Australia. Production of primary metal during 1976 increased 16% to 160,500 tons.

The Gove bauxite and alumina project in Arnhem Land operated continuously throughout 1976. The annual design capacity of about 1 million tons of alumina and 2 million tons of bauxite was attained.

Alcoa, a fully integrated producer of bauxite, alumina, primary aluminum, and fabricated products, operated mines at Jarrahdale, Del Park, and Huntly, all in the Darling Range. Bauxite, mined at Jarrahdale, supplied a refinery at Kwinana, south of Perth, and the refinery at Pinjarra used bauxite mined at Del Park and Huntly. The company's smelter at Point Henry, Victoria, gradually increased output to the rated capacity of 90,000 tons per year.

Exports of alumina reached a record 5.8 million tons, valued at about $527 million, compared with 4.5 million tons valued at $344 million in 1975. The average unit value of alumina exports continued to increase during the year, and at yearend it was $98.93 per ton f.o.b. Aluminum exports dropped 19% from those of 1975. However, the higher price obtained in 1976 resulted in a total value of $45 million, only slightly less than the 1975 value of $46 million.

Copper.—Economic conditions in the copper market remained depressed throughout the year, and production declined in all sectors of the industry. Mine production by Mount Isa Mines Ltd. (MIM) in Queensland, which supplies about 70% of Australia's output, decreased 2% from that of 1975. Output by Cobar Mines Pty. Ltd., located in New South Wales, was reduced 40%, and the approaching end of the economic life of Mount Morgan Ltd. in Queensland was made public. In midyear, the Kanmantoo mine in South Australia was placed on care-and-maintenance, and it was announced that operations of Mount Lyell Mining & Railway Co. Ltd. at Mount Lyell were to be drastically reduced and 400 employees laid off, leaving only the Prince Lyell ore body in production.

Owing to the lack of demand, production at several of the smelters and refineries was also scaled down. The MIM refinery at Townsville, Queensland, operated about 9% below plant capacity of 160,000 tons per year. At Electrolytic Refining and Smelting's refinery at Port Kembla, New South Wales, processing of Cobar concentrates and some concentrates from Mount Lyell declined about 30%. The smelter at Tennant Creek was closed and the mining emphasis there was switched to gold, with the byproduct copper being treated at Mount Morgan.

At Mount Isa, copper production was maintained at a level consistent with the depressed market. The quantity of ore treated decreased 12.8% (4.3 million tons) from that of 1975. About 94% of the total ore mined came from the 1100 ore body. Over 27.8 million tons of ore has been recovered from this ore body since mining began in 1967. At the copper smelter, construction work proceeded throughout the year on the electrostatic precipitator for the fluo-solids roaster. A fume hood, which completely encloses the unit, was installed on one of the converters. The output of refined products from the Townsville copper refinery dropped about 9%, in line with the output of blister copper from MIM. Design work and equipment procurement for a continuous-casting and rod-rolling installation proceeded. The plant design incorporated the new process for metal rolling previously developed at the refinery.

At MIM's Hilton mine, development work was scaled down in response to difficult economic conditions. However, ore processing investigations proceeded. The metallurgical characteristics were quite different from those associated with Mount Isa ores, particularly with respect to the silver minerals, which were unusally refractory. Primary ore reserves on June 30, 1976, were reported as 135 million tons with an average grade of 3.2% copper. Reserves of secondary ore were 150 million tons containing 3.8% copper.

Mount Lyell Mining & Railway milled 2.2 million tons of ore and produced

21,299 tons of copper concentrates at its Queenstown, Tasmania, plant. Ore mined was 85,609 tons less than in the previous year owing to a reduction in quantity from the two principal sources, Prince Lyell and Cape Horn. The share of ore produced from underground sources amounted to 91.5% of total production. Underground operations were at the pillar recovery stage, and this was the primary reason for lower tonnage and grade of ore. Also, production from Cape Horn was severely curtailed early in the year owing to a major pillar collapse.

Peko-Wallsend's copper mining operations at Tennant Creek, Northern Territory, remained closed throughout 1976. However, 3,658 tons of copper concentrate was produced as a byproduct of mining gold-bismuth ore at the Warrego mine. Even with the upward trend in copper prices, operations were not expected to resume until about mid-1978 because of major changes to the copper smelter and plans to build a bismuth plant. Through its own research, Peko-Wallsend designed a differential flotation process that separates bismuth into a separate concentrate.

Cobar treated 594,430 tons of ore, from which 33,502 tons of copper concentrate containing 25.5% copper was recovered. Improved metallurgical operations achieved a higher-grade copper concentrate, which continued to be sold to Electrolytic Refining and Smelting. Mine development totaled 1,627 meters (2,483 meters in 1975) including 1,229 meters for development of open stopes. Development was limited to the opening up of ore bodies already accessible from existing development. A total of 3,286 meters of exploratory diamond drilling was completed (4,807 meters in 1975). Drilling was almost entirely directed toward determination of ore boundaries for open stoping above the 630-meter level.

Kanmantoo Mines Ltd. in Kanmantoo, South Australia, managed by Broken Hill South Ltd. (BH South), was closed in early 1976. Increased operating expenditures and the low price of copper which persisted for most of the year were the major factors contributing to the closure. The crushing, grinding, and flotation plant operated for 11 months on ore stockpiled in previous years. During that time, 104,278 tons of ore was treated to produce 3,122 tons of a 25.57% copper concentrate.

Table 4.—Australia: Major copper production, by company

Facility	Production (metric tons)[1]		
	1974	1975	1976
Mines:			
Mount Isa Mines Ltd	152,510	150,112	146,979
Mount Morgan Ltd	9,587	8,241	6,420
Cobar Mines Pty. Ltd	8,720	9,713	5,840
Mount Lyell Mining & Railway Co. Ltd	23,331	23,240	19,440
Electrolytic Zinc Co. of Australasia Ltd. (EZ Co.)	1,845	1,278	1,723
Peko-Wallsend Ltd	14,773	14,525	9,543
Smelters:[2]			
Mount Isa Mines Ltd	130,805	160,525	149,620
Mount Morgan Ltd	9,100	9,900	7,646
Electrolytic Refining and Smelting Co. of Australia Ltd.[3]	r 21,641	r 20,505	23,280
Refineries:[4]			
Mount Isa Mines Ltd	130,805	148,370	135,017
Electrolytic Refining and Smelting Co. of Australia Ltd.[3]	28,340	26,280	17,393

r Revised.
[1] Metal content of ore.
[2] Primary blister copper.
[3] Treats concentrates from Cobar.
[4] Primary electrolytic copper.

Gold.—Output was about 6% below that of 1975. Closure of a number of the larger mines was offset somewhat by increased production from the Central Norseman Gold Corporation N.L. mine in Western Australia, the Warrego mine in the Northern Territory, and the Blue Spec mine at Nullagine, Western Australia, which started production in mid-1976. The Warrego mine was the only producing mine of the Peko-Wallsend group after the closure of two mines (Peko and Juno) and the cessation of production from the Gecko mine. Increased gold output at the Central Norseman mine and at Warrego was owing principally to the higher grade of ore mined.

The devaluation of the Australian dollar at the end of 1976 effectively increased the Australian producers' price of gold, which could help the few surviving mines. The Liberal Government did not restore the special concessions to the gold industry removed by the previous Labor Government, and the investment allowance was of little direct benefit to the older mines.

Despite the general gloom over the gold mining industry, two new mines were under development in Western Australia. They were the Blue Spec mine, operated by Australian Anglo American Ltd., and the Telfer mines in the Paterson Range, a joint venture of Newmont Pty. Ltd. (70%) and BHP (30%). The Blue Spec mine commenced operations in March. The Telfer mine, in remote north-central Western Australia, experienced considerable delays as a result of industrial disputes, but the mine and mill were expected to be commissioned in early 1977. Newmont is expected to mine 4.2 million tons of ore averaging 0.28 troy ounce of gold per ton by open pit methods over the next 10 years. A mill with a capacity of 1,350 tons per day would recover the gold by standard gravity methods and the cyanide process. Because of the remote location of Telfer, living facilities for about 100 families have been constructed at the site.

Virtually all of the gold from the Northern Territory was produced by Peko-Wallsend in the Tennant Creek area. Output was increased as a result of expanded production from the Warrego mine. The main shaft was extended to 746 meters, which was the depth initially planned. Mine development continued to define the Warrego gold and copper ore body. Development openings totaling 1,930 meters were completed. Reserves were 830,000 tons of ore averaging 1 troy ounce of gold per ton.

The Central Norseman mine, 50.5% owned and wholly managed by Western Mining Corporation Ltd. (WMC), produced 32,000 troy ounces of gold during the year. The Central Norseman mine was an underground operation with 12 working levels. The gold occurred in quartz veins in Archaean basic igneous rocks. Ore reserves were estimated at 400,000 tons averaging 0.53 troy ounce of gold per ton.

The principal gold producers and quantities recovered during 1976 were as follows:

Company	Production (troy ounces)
Central Norseman Gold Corporation N.L	32,000
Golden Plateau N.L	12,450
Kalgoorlie Lake View Pty. Ltd	103,550
Mount Lyell Mining & Railway Co. Ltd	13,188
North Kalgurli Mines Ltd	1,400
Peko-Wallsend Ltd	199,000

Iron and Steel.—Australia's iron and steel industries declined on all fronts in 1976, reflecting reduced demand, effects of industrial disputes, and adverse weather in the Pilbara region of Western Australia. Ore production declined 4.5%, and iron and steel output decreased 1%. Although domestic demand for steel remained fairly static, production was maintained early in the year through export sales. Export orders declined sharply during the latter part of the year, and output was reduced, as industrial disruptions by seagoing and waterfront unions resulted in the loss of 1,000 ship-days. This caused serious interruptions in shipments of iron ore to world markets.

Five major companies operating in the Pilbara region produced nearly 90% of Australia's total iron ore. They were Hamersley Iron Pty. Ltd. (Mount Tom Price and Paraburdoo), Mount Newman Iron Ore Pty. Ltd. (Whaleback Hill), Cliffs Western Australian Mining Co. Pty. Ltd. (Robe River), Goldsworthy Mining

Ltd. (Mount Goldsworthy, Shay Gap, and Sunrise Hill), and Dampier Mining Co. Ltd. (Koolan Island and Yampi Sound). Outside the Pilbara region, iron ore at Koolyanobbing was mined by Dampier for use in the Kwinana blast furnace. In South Australia, BHP produced ore from the Middleback Ranges for the steel plants at Whyalla and in New South Wales, and for pelletizing at Whyalla for export. About 2.2 million tons of ore was mined at the Savage River operation in Tasmania by a consortium of Australian, U.S., and Japanese companies. The ore was slurried and pumped to a pelletizing plant at Port Latta and shipped to Japan.

The iron ore industry was almost entirely export oriented, and Australia remained the world's largest iron ore exporter. In the world market in 1976, iron ore was the fourth highest commodity in terms of export receipts. Receipts of $774 million amounted to 19% of Australia's total value of commodity exports, second only to coal. This ranking was achieved in recent years and was due primarily to demand generated by the Japanese steel industry. Exports of some 62 million tons of ore to Japan accounted for approximately 87% of Australia's total iron ore exports for the year.

Iron ore sales to Japan were by long term contracts with very few spot sales. Several prices applicable to long term contracts of Australian producers were due for renegotiation in 1977, and talks were in progress during 1976. Market prices in Japan tended to lag behind those in other markets, particularly the European market, because of Japan's strong bargaining position against Australian oversupply.

Ore prices varied between contracting companies, as prices were negotiated by the individual exporter. Hamersley Holdings Ltd. and Mount Newman reached an agreement with Japan in April for price increments over a 2-year period. Hamersley's number one contract was for 5 million tons of ore annually. Lump ore remained at $13.86 per ton f.o.b. until October 1977 and would then increase to $18.43. Fines remained at $10.87 per ton until October 1977 and would then increase to $14.76. The Mount Newman contract covered 5.5 million tons annually. Lump ore began in October 1976 at $13.93 per ton and would increase to $18.81 in October 1977. Fines were to increase from $11.20 per ton to $14.00 per ton during the same period.

Production of iron ore by Hamersley was 30.7 million tons, compared with 36.1 million tons in 1975. This decline resulted from industrial disputes and the introduction of a planned program of reconstruction of major ore handling equipment to eliminate structural and operating inefficiencies. Hamersley announced a project to increase its annual capacity 6 million tons to 46 million tons of salable ore by the treatment, including concentration, of 13.5 million tons of Mount Tom Price low-grade ore. Previously, most of this ore was discarded as waste. The total cost of the beneficiation plant would be approximately $375 million. The new investment would enable Hamersley to defer until 1980 its commitment to submit proposals for a direct-reduction plant using its HImet process. The deferment of the direct-reduction plant was consistent with expected availability of gas from the Northwest Shelf of Western Australia, on which the viability of the HImet process would depend.

Output by the Mount Newman consortium, a joint venture operated by Mount Newman Mining Co. Pty. Ltd., was 18% lower than that of 1975. The decline was attributed to an unprecedented number of prolonged strikes that affected Mount Newman's operations. Despite the strikes and worldwide recession in demand for steel, expansion of Mount Newman's production capacity to 40 million tons per year was completed. Consideration was being given to a further expansion of 5 million tons, which would involve construction of a heavy media beneficiation plant to upgrade ores presently being stockpiled.

Industrial disputes also adversely affected production by Goldsworthy, resulting in a 12% reduction during the year. Iron ore was produced at Mount Goldsworthy, Shay Gap, and Sunrise Hill. Ore from Shay Gap and Sunrise Hill was railed 182 kilometers by way of Mount Goldsworthy to Port Hedland. The rail distance from Port Hedland to Mount Goldsworthy is 113 kilometers. Ore shipments in 1976 averaged 63.4% iron.

The principal Australian iron ore producers and their output in 1976 were as follows, in thousand tons:

Company	Location	Products	Output
Broken Hill Pty. Co. Ltd	South Australia	Lump and pellets	5,302
Do	Western Australia	Lump	2,774
Goldsworthy Mining Ltd	do	do	7,091
Mount Newman Mining Co. Pty. Ltd	do	do	27,200
Hamersley Iron Pty. Ltd	do	Lump and pellets	30,682
Savage River Mines	Tasmania	Pellets	2,193

Australian reserves of iron ore were estimated at 35 billion tons, comprising 25.8 billion tons of hematite with 54% or more iron content and 9.2 billion tons of limonite with 50% or more iron content. A large proportion of Australia's reserves occur in the Pilbara region of Western Australia, which accounted for 90% of Australia's production of iron ore in 1976. New mines in the area, however, are unlikely unless iron ore prices rise substantially, as none of the three planned projects is economically viable at present prices. Japanese steelmills announced that they would not take part in any new Western Australian iron ore projects for at least 2 years.

BHP was Australia's sole producer of steel, output of which was slightly less than that of 1975. The steel division encompassed the operations of the integrated iron- and steelmaking plants at Newcastle, Whyalla, and Port Kembla and the iron-producing and steel-rolling activities at Kwinana. Steelmaking capacity was about 9 million tons per year. BHP announced plans to increase this capacity to about 15 million tons per year in 10 to 15 years, depending on domestic requirements. At many BHP facilities, expansion plans were completed or in various stages of progress. At Port Kembla, completed work included additional bloom mill soaking pits, stage 1 of the ingot mold foundry conversion, and additional diesel locomotives and rolling stock. Work was in progress on several other major projects, including the continuous slab casting and vacuum degassing plant, relining the blast furnace, and additional hot metal ladles. Modifications and additions were also being made to the flat products division and the ingot mold foundry. Projects completed at Whyalla included the deepening of the harbor and access channel, additional soaking pits at the bloom mill, and the mill tracking computer system. Major work still in progress included the construction of a battery of coke ovens and the extension of the tonnage oxygen plant.

Lead and Zinc.—Mine production of lead decreased 2%. Increased output at Mount Isa failed to offset a decline in production at Broken Hill, New South Wales, where lower output was recorded from most mines and where Minerals Mining and Metallurgy Ltd. (MMM) ceased underground operations in August because of unfavorable economic conditions. Mine production of zinc, however, decreased 7%. Over 60% of the total production of lead and zinc came from three mines and one treatment operation at Broken Hill and Mount Isa. Most of the remaining output was from the west coast mines in Tasmania and the Cobar mine in New South Wales.

MIM remained Australia's largest single producer of lead and zinc. During 1976, 2.4 million tons of lead-zinc ore was mined at average grades of 7.0% and 6.7%, respectively. Ores were extracted by cut-and-fill and open stoping with subsequent pillar recovery methods. Some 14 separate narrow ore bodies were being mined by cut-and-fill stoping, with a productivity of 30 tons per shift.

Mine output by Australian Mining and Smelting Co. Ltd.'s (AM&S) two subsidiaries, Zinc Corporation Ltd. and New Broken Hill Consolidated Ltd. (NBHC), was at the same level (1.87 million tons) as in the previous year. This level was maintained despite problems encountered at NBHC with large fragmentation after primary blasting in some longhole stopes and a series of curtailments in a critical auxiliary ore pass. Emphasis continued to be placed on development for longhole stoping in both mines where practicable. Investigation of sandfill consolidation and of pillar mining methods commenced with the aim of improving the productivity of future extraction of pillars of ore remaining between primary stopes. The Zinc Corporation concentrator commenced production on a trial basis of two product grades of zinc concentrate with a view to optimizing conditions and achieving a greater recovery of zinc metal. Considerable difficulties were experienced with

some items of equipment in re-treating old mine residues in the new plant. However, it was expected that the planned rate of concentrate production would be achieved in early 1977.

An improvement in zinc metal markets enabled the Sulphide Corporation Pty. Ltd. smelter at Cockle Creek, New South Wales, to operate at 70% capacity during the year. A more diverse range of raw material was processed through the smelter. Fuel oil injection through the tuyeres of the I.S. Furnace as a partial substitute for the more expensive coke resulted in a substantial saving in fuel costs. Development of briquetting technology for recycled process materials continued successfully, with the pilotplant operating on a semi-commercial basis.

The Broken Hill Associated Smelters Pty. Ltd. (BHAS) smelter at Port Pirie, South Australia, increased refined lead and zinc output 13% and 12%, respectively. Oxygen enrichment was used to increase the smelting capacity of the blast furnace. Research on reflux refining of lead in collaboration with the Commonwealth Scientific Industrial Research Organization (CSIRO) was continuing. The company is committed to a pilot development process for several years.

EZ Co., a subsidiary of EZ Industries Ltd., increased production at its Rosebery, Farrell, and Hercules mines near Rosebery, Tasmania. Combined output totaled 517,683 tons. The Rosebery mine, by far the largest, was also the site of the concentrating mill for ore from all the locations. Rosebery and Hercules are zinc-lead-copper deposits in association with gold, silver, and pyrite. The Farrell mine is a silver-lead-zinc vein deposit. The average grade of production in the mines was 10% lead and 10 troy ounces per ton silver. The products of the concentrating mill were zinc, lead, copper, and pyrite concentrates, which were railed to the port of Burnie. There were 11 line-haul locomotives and 69 bulk wagons of 44-ton capacity on the railway. Traffic on the line exceeded 500,000 tons per year.

MIM began operating a pilotplant at McArthur River, Northern Territory, as part of its feasibility study for what could become a zinc-lead project. The plant, which comprises a mine and a 50-ton-per-day pilot concentrator, would be operated initially for 1 year, after which progress would be reviewed. MIM has conducted work at McArthur River for several years, but development was hindered by metallurgical problems involved in concentrating the fine-grained McArthur River ore.

A consortium consisting of Conzinc Riotinto of Australia and St. Joe Minerals Corp. and Phelps Dodge Corporation of the United States was undertaking an $80 million development of a deposit in New South Wales known as Woodlawn. The mine is expected to be producing by 1978 at an ore production rate of 3,000 tons per day. The concentrate produced would be taken by each of the participants in proportion to their equity. Each company has a one-third interest in the project. Diamond drilling revealed ore reserves of 10 million tons, averaging 9% zinc, 3.5% lead, 1.8% copper, and 1.8 troy ounces per ton silver.

Table 5.—Australia: Lead-zinc production, by major company
(Metric tons)

Mine	1974		1975		1976	
	Lead	Zinc	Lead	Zinc	Lead	Zinc
North Broken Hill Ltd	58,383	46,922	57,192	39,308	62,840	44,425
Zinc Corporation Ltd	74,850	62,800	78,950	88,700	78,210	55,800
New Broken Hill Consolidated Ltd	71,150	114,200	83,120	116,300	71,790	136,200
Mount Isa Mines Ltd	124,381	103,061	131,689	115,209	132,910	99,750
Electrolytic Zinc Co. of Australasia Ltd. (Read-Rosebery)	26,311	76,777	18,162	60,801	29,000	67,600

Manganese.—Production of manganese ore increased substantially over that of 1975. More than 90% of the country's output was supplied by the Groote Eylandt Mining Co. Pty. Ltd. (GEMCO), a subsidiary of BHP, where production declined slightly. The $20 million expansion program to increase capacity to 2 million tons was completed during 1976.

GEMCO exported 1.96 million tons of manganese ore from its operations in the Northern Territory. The largest tonnage (860,000 tons) went to Japan. About 570,000 tons was shipped to Europe, 220,000 tons to the United States, and 45,000 tons to the Republic of Korea. The remaining 265,000 tons was domestically consumed and processed by the Bell Bay plant operated by Tasmanian Electro Metallurgical Co. Pty. Ltd. (TEMCO), a subsidiary of BHP. The plant produced about 60,000 tons of ferromanganese and 10,000 tons of silicomanganese. Operations were expanded during the year with the commissioning of a 39,000-kilovolt-ampere ferrosilicon furnace with a capacity of 25,000 tons per year and a manganese ore sinter plant of 220,000 tons per year. The latter would treat manganese ore fines that were not readily salable unprocessed. A new 24,000-kilovolt-ampere manganese alloy furnace was under construction and should be completed in early 1977. When the expansion is completed, the plant would require about 250,000 tons of manganese ore annually, doubling the present output.

A new contract between BHP and the Japanese ferroalloy industry was reached in June. The new agreement increased the price of metallurgical-grade manganese ore 8.6% to $51.40 per ton. Longreach Metals N.L. also agreed to sell ferromanganese ore to Japan in 1977. The contract with Nippon Steel Corporation was for 5 million tons per year over a 5-year period. The ore would be produced at the company's Woodie Woodie Creek and Ripon Hills deposits in the Pilbara region. Bulk loading and storage facilities were being constructed at Port Hedland, Western Australia.

Australian reserves were estimated at 891 million tons, the main part of which were on Groote Eylandt. The remainder were located principally in the east Pilbara and Peak Hill regions of Western Australia and at Pernatty Lagoon in South Australia. Known deposits in Queensland and other deposits in the Northern Territory were subeconomic.

On the exploration front, large manganese deposits along the outcrop of the Marra Mamba iron formation in the Pilbara were being evaluated. These secondary enrichment deposits were low in silica and consisted of about equal proportions of high-grade ore (40% manganese) and lower-grade ores suitable for beneficiation.

Nickel.—Australia remained the world's fourth largest nickel producer. Production increased about 10% in 1976, largely the result of rising output from recently commissioned mines and improvement in market conditions. Western Australian sulfide mines accounted for about 64% of the total Australian mine production. The remaining 36% was produced at the Greenvale lateritic nickel mine in Queensland.

The Kambalda mine in Western Australia was the largest single nickel producer, accounting for nearly 50% of Australia's total output. Other Western Australian mines were Windarra, Scotia, Nepean, Redross, and Spargoville, all within 300 kilometers of Kalgoorlie. In addition to operating the Kambalda and Scotia mines and managing the Windarra mine, in which it has 50% interest, WMC owned the smelter at Kalgoorlie and the refinery at Kwinana. WMC purchased ore from the Nepean mine and concentrates from Spargoville for toll treatment. Output by WMC was about 61,000 tons in 1976. Ore treated at the Kalgoorlie smelter reached 2.0 million tons containing 2.9% nickel.

Redross and Spargoville were operated throughout the year, but both incurred losses. Neither plant ran at full capacity owing to technical difficulties commonly associated with building up production of small mines and the lack of skilled miners. Production was maintained at Nepean, and full operations were resumed at Scotia after a year of restricted work following a cave-in. Operations were suspended at Carr Boyd, and the mine was put on a care-and-maintenance basis (after less than 2 years' production) because it was unprofitable.

The other major producer of nickel was the Greenvale project in Queensland,

owned equally by Metals Exploration Ltd. and Freeport of Australia Inc. The Greenvale project was the first of its kind in the Southern Hemisphere and the second largest in the world. After some serious financial and technical problems, the Greenvale operation officially began in January 1976. The major problems on the technical side were excessive wear on the crushing equipment (owing to hard silica in the lateritic ore), failure of the ore coolers, and insufficient capacity in the reduction furnace. The project was much more costly to establish than the sulfide counterpart, mainly because a treatment process had to be developed. Financial restructuring was necessary to insure the survival of the project, and the Queensland government was instrumental in saving the operation by guaranteeing capital and interest repayments on loans made to Greenvale and organizing the deferment of repayments until March 1977. Most of the plant operated at design capacity, but problems remained in the ore coolers and carbonate calciner.

Of several potentially viable development projects, the only one in progress was at Agnew, Western Australia. In mid-1975, the partners, Western Selcast (Pty.) Ltd. (60%) and M.I.M. Holdings Ltd. (40%), deferred further work until the economic climate improved. In early 1976, work was again continued but in a modified form. The original plan to produce 25,000 to 30,000 tons of nickel matte per year was deferred, and development commenced on a plant to produce 10,000 tons of nickel in concentrate annually. Expenditures were expected to be in excess of $100 million, and production could commence in 1978. The concentrate would be smelted in Kalgoorlie, and the partnership would contribute $20 million to the cost of a new smelter there. The ore body contains about 40 million tons averaging 2% nickel.

Exploration activity was fairly low key, as work continued mainly on existing prospects. However, Endeavour Oil Company N.L. announced that diamond drilling had indicated significant additions to the known ore reserves at its Digger Rocks prospect at Forrestania, Western Australia. Endeavour indicated that the sum of possible and probable ore reserves at Digger Rocks together with those of another prospect in the area were sufficient to bring the Forrestania reserves to 8.8 million tons of 1.9% nickel ore. Nickel exploration also continued in the Kimberleys of Western Australia in an area 250 kilometers southwest of Kununurra. In this area Australian Anglo American, Australian Aquitaine Petroleum Pty. Ltd., BHP, and Kennecott Copper Corporation were all active.

Silver.—Most silver produced was a byproduct from lead-zinc mines, with gold and gold-copper mines making a significant contribution. Total silver production was up about 7% from the 1975 total. About 87% of the output came from Mount Isa in Queensland and Broken Hill in New South Wales. Silver was also produced as a byproduct of copper mining at Tennant Creek, Mount Morgan, Cobar, Kanmantoo, and Mount Lyell.

MIM was Australia's largest producer of silver. Some 2.5 million tons of lead-zinc ore averaging 5.5 troy ounces of silver per ton was treated to produce approximately 9,450,000 troy ounces of silver. Some 82% of the silver was recovered from lead concentrate, slightly higher than in 1975. Some silver was also recovered from copper concentrate. All Mount Isa lead concentrate was smelted to bullion at the mine site, and silver was recovered from the bullion at MIM's primary lead refinery in the United Kingdom. Zinc concentrate was generally exported, but some shipments were made to the Risdon refinery in Tasmania. Silver was reported in tankhouse slimes at MIM's electrolytic copper refinery at Townsville. The slimes were treated by Electrolytic Refining and Smelting at Port Kembla for recovery of the silver and other contained metals.

The Broken Hill area was the second greatest source of silver. Output in recent years, however, continued to decline as an increasing proportion of ore was mined from the southern end of the field (zinc-rich lodes), where the ore's silver content was lower. Most silver produced at Broken Hill was contained in lead concentrates, which were processed at BHAS's smelting and refining plant at Port Pirie, South Australia.

The Perth mint produced silver from gold bullion received from Western Australian mines. Silver was also recovered by EZ Co. as a byproduct of zinc refining at Risdon, Tasmania. In 1976, the company

processed 588,730 tons of ore averaging 6 troy ounces of silver per ton and produced 2.8 million troy ounces of silver.

About 81% of all silver exported was contained in lead bullion, lead, zinc, and copper concentrates, blister copper, and various slags, mattes, and residues. The remainder was exported as refined silver and mint bullion.

Principal producers of silver and output in thousand troy ounces during 1975 and 1976 were as follows:

Company	1975	1976
Electrolytic Zinc Co. of Australasia Ltd	2,468	2,780
Mount Isa Mines Ltd	11,008	9,450
New Broken Hill Consolidated Ltd	1,559	1,739
North Broken Hill Ltd	2,925	2,738
Zinc Corporation Ltd	1,753	1,621

Tin.—Reversing the trend of the past several years, tin production was about 8% greater than that of 1975, despite export quotas imposed by the International Tin Council (ITC) during the first half of 1976, when production by some companies declined 60%. This had a corresponding effect on financial results, which were already affected by a decline in domestic tin consumption. Conditions changed in the second half of 1976, and Australian producers made every effort to take advantage of the market which turned in favor of sellers. After lifting the quota restrictions, the ITC exhausted its stockpile in trying to maintain the price of tin below the buffer stock ceiling. With no buffer stock, the ITC effectively lost control of prices, and at yearend the London Metal Exchange (LME) cash price reached the equivalent of $8,700 per ton compared with $4,700 per ton 12 months earlier.

Renison Ltd. remained Australia's principal tin producer and has the distinction of being the world's largest tin producer from a hard-rock underground mining operation. Ore treated during the year totaled 494,340 tons, 13% above the previous year's total. Tin metal in concentrates increased from 3,889 tons to 4,010 tons. Concentrator throughput increased 42,000 tons (9%) over that of the previous year, but the head grade was marginally lower at 1.24% tin compared with 1.25% tin in 1975. Overall recovery of tin metal dropped from 68.8% to 65.3%. Renison's proven and probable ore reserves increased 839,000 tons, but the average grade dropped slightly from 1.34% tin to 1.24% tin. Proven ore reserves totaled 6.24 million tons and probable reserves, 3.65 million tons.

The name of Cleveland Tin N.L., another major tin producer, was changed to Abminco N.L. after the company acquired a number of mining properties in Australia. Other acquisitions of Abminco N.L. included Ardlethan Tin N.L., Aberfoyle Tin N.L., Aberfoyle Management Pty. Ltd., Cominco Australian Pty. Ltd., Cominco Exploration Pty. Ltd., and a one-third interest in Mineral Sales Pty. Ltd. The Cleveland deposit is located 100 kilometers southwest of Burnie, Tasmania. Mine development was underground by trackless methods, and the milling and refining facilities consisted of gravity and flotation circuits on site. Approximately 363,000 tons of ore, with head grades of 0.73% tin and 0.27% copper, was treated to produce 1,519 tons of tin in concentrate. The concentrate was shipped to Associated Tin Smelters Pty. Ltd. in Sydney and to smelters in Penang, Malaysia.

Minops Pty. Ltd. commenced production in early 1976 from the old Razorback tin mine in the Zeehan area. Mining operations would initially be open pit, and output, about 60,000 tons annually. Minops represents a joint venture between Amalgamated Petroleum N.L. and Apollo International Minerals N.L.

Renison entered a joint venture with Minefields Exploration Ltd. of Melbourne to explore a tin prospect at Mount Moss, north of Townsville, Queensland.

Titanium and Zirconium.—Overall domestic production of mineral sand concentrates increased only slightly from the 1975 total owing to a weak market and lower prices throughout the year. This, combined with an increase in exports, brought production and shipments of some mineral sands into better balance. In particular, the high level of ilmenite stocks accumulated in 1975 was substantially reduced during 1976, although stocks of zircon concentrates continued to accumulate. Production of ilmenite concentrates was maintained at the 1975 level of about 1 million tons. Output of zircon and rutile concentrates from new operations at En-

eabba, Western Australia, raised the 1976 production of these minerals 8% and 7%, respectively, over that of 1975.

On November 10, the Federal Government announced that it would exercise its export control powers to stop sand mining on most of Fraser Island, located off the Queensland coast. The mining ban became effective December 31, 1976. The Government decided to accept the recommendations of the Fraser Island Environmental Inquiry, which called for the cessation of mineral sands mining. The greatest impact of the Government's decision fell on Queensland Titanium Mines Pty. Ltd. and Dillingham-Morphyores Inc. Pty. Ltd., the only mining ventures on the Island. Approximately 350 people were directly or indirectly involved in beach sands mining operations on the Island. The Island contained about 9% of the recoverable rutile reserves in Australia and about 15% of those located on the east coast. Zircon reserves were equal to about 5% of the recoverable reserves in the whole of Australia, and about 17% of those available from the east coast.

In June 1976, Western Titanium Ltd. began commissioning its $20 million mineral sands project at Eneabba. Annual production capacity of the plant was rated at 30,000 tons of rutile, 60,000 tons of zircon, and 150,000 tons of ilmenite.

At Jurien Bay, WMC's mineral sands plant was commissioned early in the year, and by yearend some 9,000 tons of rutile and 1,800 tons of zircon had been produced. Progress was made in overcoming technical problems. Plant modifications were necessary to achieve design capacity, particularly in the zircon plant where semiprocessed material was stockpiled. The modifications were to be completed during the latter part of the year. The assets of the company, previously named WMC Mineral Sands Ltd., were incorporated in WMC, and the operation is now a wholly-owned subsidiary under the name WMC Mineral Sands Operation.

Allied Eneabba Pty. Ltd. completed work on its wet separation plant at Eneabba and the dry separation plant at Geraldton. The company's annual capacity was increased to 250,000 tons of ilmenite, 120,000 tons of zircon, and 50,000 tons of rutile. The concentrates were shipped by road from Eneabba to Geraldton. In early 1976, bulk shipments of ilmenite, zircon, and rutile concentrates were made.

At Naracoopa on the east coast of King Island, Tasmania, Kikuka Mines Pty. Ltd. produced 5,800 tons of rutile concentrate and 8,300 tons of zircon concentrate. Plant modifications continued, and a mill to produce zircon was commissioned in February.

Jennings Mining Ltd. achieved production capacity of 40,000 tons of rutile, 30,000 tons of zircon, and 165,000 tons of ilmenite; shipments were maintained throughout the year. Further capital works included two 60-meter-diameter thickeners and a powerhouse at Eneabba and storage facilities at Geraldton.

Research was carried out on the application of plasma arc technology to titanium processing and zirconium dioxide production. The technology was developed by Ionare Smelters Ltd. It was also announced that zircon-based refractory bricks were to be used for ladle linings in a major Australian steel plant. This resulted from a program introduced several years ago by Associated Minerals Consolidated Ltd. in conjunction with CSIRO.

Proven and probable reserves of heavy minerals in Western Australia totaled about 70 million tons and in Queensland and New South Wales, over 20 million tons. The grade of heavy minerals ranged from 1% near Newcastle, New South Wales, to 80% at Eneabba. All producing companies conducted exploration to maintain reserves. However, because of increasing pressure from conservationists, the emphasis on exploration was shifting to the west coast.

NONMETALS

Phosphate Rock.—Queensland Phosphate Ltd. (QPL), a wholly-owned subsidiary of BH South, produced phosphate rock on an interim basis while the transport, treatment, and support facilities were under construction. When completed, QPL's capacity would be 1 million tons per year. The interim treatment plant produced 167,712 tons of phosphate rock in 1976.

Work was being completed at a rapid pace. The 68-kilometer rail extension from the Great Northern Railway to the mine was completed, and rail transport from the mine to the port at Townsville commenced. At Townsville, the railcar

dumper was commissioned, allowing ore transportation in the new rail wagons. Additional installations under construction included a conveyor system, storage building, and dryer. Also, the first stage of the township being built to house personnel was completed.

Long term contracts, both domestic and export, were held for 800,000 tons per year, and letters of intent were held for the remaining 200,000 tons. Estimated expenditure, including working capital, was expected to reach $75 million by the time the 1-million-ton-per-year project was fully operational. Australia is well placed geographically to supply growing Asian demand, providing labor costs and industrial unrest are kept at reasonable levels to remain competitive.

Australia's reserves were contained in 10 deposits in Queensland and the Northern Territory. About two-thirds of the reserves were in the Phosphate Hill deposit, 60 kilometers south of Duchess, Queensland. All 10 deposits were discovered by BH South. The larger BH South deposits contained an estimated 2.1 billion tons of phosphate rock at an average grade of 17.1% P_2O_5.

Australia imported 1.5 million tons of phosphate rock in 1976, valued at $53 million. This figure represents a decline of 43% from the 1975 tonnage total. Sources of imports were Nauru, a Pacific island, and Christmas Island in the Indian Ocean.

Salt.—Both production and export of salt decreased slightly in 1976. Five major companies, Texada Mines Ltd., Dampier Salt Ltd., Leslie Salt Co., Lefroy Salt Pty. Ltd., and Shark Bay Salt Pty. Ltd. (all based in Western Australia) produced about 85% of the total domestic output. Producers in South Australia, Victoria, and Queensland accounted for the remainder. All production was by solar evaporation using either seawater or natural brines associated with inland lakes. In the Pilbara region of Western Australia, the future of the salt industry appeared brighter if recommendations were accepted by the Federal and State governments that the industry form an integral part of the petrochemical complex.

In Western Australia, production of 3.7 million tons, valued at $26.4 million, was slightly lower than that of 1975. Texada reported salt production totaling 1.2 million tons, and shipments were made from the company's port of Cape Cuvier near its production facilities on Lake McLeod. Approximately 1,800 hectares of evaporation pans was constructed on the southern section of the lake of which about 1,000 hectares was used for sodium chloride production and the balance for langbeinite ($K_2Mg_2(SO_4)_3$) production. During the year, BHP, through its subsidiary Dampier Mining, acquired 76% interest in Texada under an agreement with C. Itoh & Co., Ltd., the Japanese trading house. C. Itoh would retain a 24% interest in Texada and would continue to act as selling agent.

Dampier Salt reported production of 1.4 million tons from Mistaken Island, slightly less than the 1975 figure. Production came from 30 crystallizer ponds covering an area of 738 hectares. The company reported that work was on schedule to expand capacity to 2.4 million tons annually. Leslie Salt reported that 1976 production from Port Hedland increased slightly. The company produced about 1.5 million tons from 16 crystallizer ponds covering an area of 512 hectares. Leslie Salt reported that new markets were established in the Philippines and the Republic of South Africa, and negotiations to establish markets in Japan, the Republic of Korea, New Zealand, and Taiwan continued. Production capacity was around 2 million tons annually.

Lefroy Salt reported production of 110,000 tons of salt from operations on Lake Lefroy, compared with 152,000 tons in 1975. Construction of additional facilities to raise the total washing capacity to 500,000 tons annually was nearing completion. Shark Bay Salt, which produced a record high 265,000 tons, reported that an expansion program continued during the year.

South Australia ranked second to Western Australia in salt production. The principal producer was Imperial Chemical Industries of Australia and New Zealand Ltd. (ICIANZ) at Dry Creek, followed by BHP and Waratoh Gypsum Co. at Whyalla. Together, they accounted for 70% of that State's production of 588,000 tons in 1976. The Ocean Salt Co. at Price and the Australian Salt Co. at Bumbunga Lake were the other main suppliers.

Production in Queensland was 114,600 tons, 21% less than the previous year's

output, the decline mainly attributable to adverse weather conditions. Companies contributing to the output were Central Queensland Salt Industries Ltd. and Imperial Chemical Industries Australia Ltd. Both companies operated at Bajool, about 30 kilometers south of Rockhampton.

Sulfur.—There were no known deposits of native sulfur in Australia, but pyrite was mined for its sulfur content at several locations. Approximately 30% of domestic requirements were obtained from indigenous raw materials, and 70% came from imported brimstone. Elemental sulfur was obtained from petroleum by Petroleum Refineries (Australia) Pty. Ltd. at Altona, Victoria, and Halletts Cove, South Australia; Shell Refining (Australia) Pty. Ltd. at Clyde, New South Wales, and Geelong, Victoria; Australian Oil Refining Pty. Ltd. at Kernell, New South Wales; and Amoco (Aust.) Pty. Ltd. at Bulwer Island, Queensland. Total production of sulfur from petroleum in 1976 was about 10,000 tons.

Pyrites for sulfuric acid manufacture were produced only as a byproduct of base metal mining in Tasmania by EZ Co. and Mount Lyell Mining & Railway. The largest deposit occurred at Mount Lyell where it was associated with copper, gold, and silver mineralization. The pyrite was recovered and shipped to Victoria for acid manufacture in the company's superphosphate works. Mount Lyell Mining & Railway produced 108,442 tons of pyrite concentrate.

The zinc-lead sulfides of the Read-Rosebery district in Tasmania were also utilized for their sulfur content by the EZ Co. at Risdon, where the roaster gases were used in sulfuric acid manufacture.

Some exploration was done on pyritic black slate occurrences near Port Sorell and at Dial Range, both located in Tasmania. Tin deposits at Mount Bischoff and Renison Bell were associated with enormous deposits of pyrite and pyrrhotite and were being investigated.

MINERAL FUELS

Coal.—*Bituminous.*—Production of black coal increased to 74.9 million tons, 12% over that of 1975. New South Wales remained the largest coal-producing State, accounting for 60% of the 1976 output. The main growth in recent years, however, has been in Queensland, which produced 34% of the national output. The growth in Queensland resulted from the development of large-scale and comparatively low-cost open pit mines, which accounted for approximately 85% of Queensland's production. In New South Wales, underground mines continued to be the main source of supply, accounting for 79% of production.

The abolition of the export coal levy was accepted in principle in the 1976 Federal budget, and legislation was passed to phase out the charge over a 3-year period. As of August 1976, the levy on coking coal was decreased 25% to $4.50 per ton, while the levy on inferior grades of coal was reduced from $2.00 to $1.50 per ton. The levy on noncoking grades of coal was removed entirely.

Coal produced in New South Wales was bituminous and nearly all was mined in the Sydney Basin. More than two-thirds was high-volatile soft coking coal and steaming coal, most of which was mined in the Newcastle and Singleton areas. Small quantities were mined in the southern Maitland area and in the Western District around Lithgow. The low- and medium-volatile coal (premium hard-coking coals) was mined on the south coast and in the Burragorang Valley. Some high-volatile coal was mined on the north of the Sydney Basin at Gunnedah. Mining operations further north at Ashford and Nymboida were of low tonnage.

New mine development continued during the year, but completion of the coal loader at Newcastle and approval of a loader at Botany Bay were delayed. Major new development was underway at Warkworth, near Singleton, where recoverable reserves were estimated at 550 million tons. A 21-year lease on 4,192 hectares was granted to a consortium of H. C. Sleigh Ltd. (45%), Costain Australia Ltd. (30%), Mitsubishi Development Pty. Ltd. (15%), and the Australian Resources Development Bank (10%). Capital expenditure was estimated at $100 million, and production capacity was expected to be around 4 million tons annually. The Clutha Development group, which controls 13 operating mines and 1 under development, sold one-half of its assets to BHP for $162 million. This would provide capital necessary to increase Clutha's total

production from 5.8 million tons to 7 million tons annually.

In Queensland, both bituminous and subbituminous coal were mined. Utah Development Co. (UDC), owned 89.2% by Utah International Inc. of the United States and 10.8% by Utah Mining Australia Ltd. (UMAL), was Queensland's principal coal producer. Most of the output came from the Bowen Basin in central Queensland, which extends from Collinsville south to Cracow. About half of the State's coal was obtained from three open pit mines (Goonyella, Peak Downs, and Saraji), which had a combined annual capacity of 13.5 million tons. Coal was also mined in the Clarence-Moreton Basin, the Callide Basin, at Blair Athol, and near Maryborough.

The Queensland government announced that work on the three large development projects at Nebo, Norwich Park, and Hail Creek in the Bowen Basin would start during 1977. Evaluation of these projects had been underway for some years, but delay arose when the Federal Government required at least 50% Australian equity in the producing companies. Rearrangement of the capital structure of the companies satisfied this requirement. Capital needed to make the projects fully operational would depend largely on new rail and port facility requirements. Cost was estimated at over $1 billion in 1977 prices. The mines could take 5 years to commission and, when fully developed, would produce 14 million tons annually. Two adjoining deposits, at Gregory and German Creek in the Bowen Basin, were also being studied. BHP controlled the Gregory venture and was negotiating sales contracts to enable the open pit project to enter production at a rate of about 3 million tons per year. Other coal deposits in the Basin at Taroom, Theodore, Millmerran, and Newland were being evaluated by Australian and overseas interests. A project under consideration was the supply of coal for liquefaction, a process which the Queensland government was actively promoting. Coal from the Millmerran and Taroom areas was said to be suitable for that purpose.

Small quantities of coal were produced from open pit and underground mines at Collie, Western Australia, and from the open pit mine at Leigh Creek, South Australia. Bituminous coal was mined for use by local industry at Fingal in Tasmania. No bituminous coal was produced in the Northern Territory or Victoria.

Black coal reserves were estimated at 229 billion tons of which 35 billion tons was indicated and 194 billion tons inferred. Indicated reserves were located in New South Wales (16.2 billion tons), Queensland (15.8 billion tons), Western Australia (1.9 billion tons), South Australia (730 million tons), and Tasmania (143 million tons). Substantial deposits of coal have also been delineated in areas not being mined, notably in the Surat Basin (Queensland), at Lake Phillipson in the Arckaringa Basin (South Australia), and in the Coorabin-Oaklands Basin (New South Wales). The Joint Coal Board reported output, by State, as follows, in thousand tons:

State	1974	1975	1976
New South Wales	38,703	40,152	44,940
Queensland	21,085	22,760	25,802
Western Australia	1,446	2,114	2,143
South Australia	1,671	1,751	1,819
Tasmania	127	162	175
Total[1]	63,033	67,019	74,881

[1] Data may not add to totals shown because of independent rounding.

Domestic consumption of black coal in recent years was as follows, in thousand tons:

	1973	1974	1975
Electricity	14,787	16,253	16,454
Iron and steel	8,981	9,606	8,854
Cement	862	1,031	992
Metallurgical coke	393	478	398
Railroads and town gas	139	137	123
Other (including bunkers)	2,521	2,685	2,633
Total	27,683	30,190	29.454

Lignite.—Victoria produced all of Australia's lignite during 1976. The major deposits were in the Latrobe Valley, 200 kilometers southeast of Melbourne. Deposits were also located at Anglesea, Bacchus Marsh, and Gelliondale. The State Electricity Commission (SEC) produced 29.7 million tons, more than 95% of the State's total output, at Yallowin and Morwell. Coal was won by large dredges with an excavating capacity of 2,000 tons

per hour. The Yallowin open pit produced at a rate of 13 million tons per year. Traditionally, production from Yallowin was used to produce a high-grade solid fuel in the form of briquets for domestic and industrial use. However, briquets were used as a basis for the production of high-grade char, gas, liquid fuel products, and other chemical industry feedstocks.

The Victorian Parliamentary Public Works Committee continued to review the proposed Loy Yang development program. The proposals were for the progressive development of an open pit to serve a 4,000-megawatt power station. The first stage, comprising a 2,000-megawatt station, was planned to come into service between 1983 and 1988 and the second stage between 1989 and 1992.

Brown coal reserves were estimated at 122 billion tons (67 billion tons indicated and 55 billion tons inferred). Victoria has 66.7 billion tons of indicated reserves (12.2 billion tons salable), and the rest was in the Saint Vincent Basin of South Australia.

Petroleum and Natural Gas.—Production of both crude oil and natural gas continued the upward trend of the past decade. Crude oil production averaged 417,867 barrels per day, an increase of 1.8% over the 1975 figure. The Victorian offshore fields (Bass Strait) provided 91.8% of the total, with production of 140 million barrels, averaging 374,549 barrels per day. The remainder was supplied by Western Australia's Barrow Island Field and the Moonie, Queensland, Fields. In Western Australia production dropped from 13 million barrels to 12.5 million barrels (34,246 barrels per day), while the Queensland production dropped from 525,000 barrels to 490,000 barrels (1,342 barrels per day).

Construction for the Mackerel and Tuna Fields continued throughout the year. The Mackerel platform was completed and placed on location offshore in April. Construction of the Tuna platform was well advanced. The laying of offshore pipelines and the construction of production modules for both structures were almost complete. Mackerel was programed to be onstream in late 1977 and Tuna by 1980.

Input of crude oil and other feedstock to Australian refineries during 1976 totaled 211 million barrels. Indigenous crude oil comprised 75% of the total input with the balance imported mainly from the Middle East. Excluding exports, refinery output provided about 81% of the Australian consumption requirements for petroleum products.

Petroleum imports of 86 million barrels represented a decline of 3.8% from those of 1975. Imports of crude oil and other refinery feedstock amounted to 61 million barrels, while imports of refined products totaled 25.2 million barrels. Fuel oil was the principal product imported at 13.4 million barrels. The total cost of petroleum imports was estimated at $563 million. Exports of refinery products increased 4.8% to 26.1 million barrels. LPG at 12.3 million barrels was the main product exported. Shipments to Japan totaled 15.3 million barrels (about 60% of all refinery product exports), including 11.8 million barrels of LPG.

Consumption of petroleum products during 1976 totaled 207.4 million barrels, a decrease of 22% from that of the previous year. Gasoline consumption decreased 15% to 83.4 million barrels. Other major products consumed were fuel oil (38.7 million barrels, down 19.4%), industrial diesel fuel (11.8 million barrels, up 14.9%), and aviation turbine fuel (11.6 million barrels, up 1.2%).

On the exploration and development scene, the most significant event was the discovery of oil offshore Western Australia's Dampier subbasin. The oil flow rate from this well was the largest to date in that basin, and this discovery revived hope for other major oil discoveries in the area. Other notable wells included the Sunrise No. 1 and Spar No. 1 gas condensate discoveries in the Bonaparte Basin and the Barrow-Dampier subbasin. West Australian Petroleum Pty. Ltd. continued its investigation of deep high-pressure gas in the Middle Jurassic range on Barrow Island. Development drilling continued in the Cooper and Surat Basins.

The Australian Government was considering a proposal by an international consortium to develop large natural gas deposits off the northwestern Australian coast. If approved as expected, this would be the largest resource development ever undertaken in Australia. The gas deposits were discovered in 1972, but their development was delayed pending Government discussions concerning whether to export

or reserve for domestic needs. Plans for the $3.4 billion project called for construction of at least two offshore platforms, a 120-kilometer seabed pipeline to shore, and processing and liquid natural gas plants. A number of specialized tankers to carry the liquefied gas overseas would also be built.

Total resources of hydrocarbon liquids (crude oil, condensate, and LPG), both commercial and noncommercial, amounted to 4.4 billion barrels. Natural gas reserves totaled 31 trillion cubic feet. In terms of crude oil fields presently producing or about to produce, the country had consumed 41% of its reserves at the end of 1976. The position in regard to natural gas was much better; in terms of presently producing fields, the depletion factor was 6.6%. If all gas reserves, including the major reserves on the Northwest Shelf, are taken into account, Australia had consumed only 3% at the end of 1976.

Uranium.—Mary Kathleen Uranium Ltd. (MKU), which had been kept on care-and-maintenance since operations ceased in 1963, commenced production in early 1976. Problems encountered by MKU in reopening the mine were greater than expected, and the objective of reaching rated capacity by yearend 1976 was not achieved. By yearend, 423 tons of U_3O_8 was produced, significantly less than the original estimate of 791 tons. Adverse factors included inability to mine the previously planned ore grade, the need to redesign the pit, which increased the quantity and rate of waste rock removal from the mine, the breakdown of old machinery in the treatment plant, the need to modify new sections in the treatment plant, and adverse weather in November and December.

Because of the production problems, the company was unable to deliver contracted tonnages within the time specified. Some purchasers were asked to extend contract delivery by approximately 3 years. The factors that affected production also caused significant increases in costs, some of which were expected to continue throughout 1977. The Commonwealth Government and Conzinc Riotinto agreed to provide short term financing facilities for up to $6 million to the company.

Plans for further development of Australia's identified uranium resources were held in abeyance pending the final outcome of the Ranger Uranium Environmental Inquiry (Fox Commission). The first part of the report, which dealt with the general implications of the mining and export of uranium in Australia, was released in October 1976. It approved development of a domestic uranium industry but recommended stringent Government controls, particularly over the marketing of uranium. It also recommended the postponement of any decisions on the Northern Territory deposits until the release of the Commission's second report, which will deal solely with the environmental impact of mining in the Northern Territory. Two basic findings of the first inquiry were that, if properly regulated and controlled, the hazards of uranium mining and milling were not sufficient to justify a decision not to mine and sell Australian uranium. The Commission also recommended that ample time be given for public consideration of the report, including Parliamentary debate, before any decisions on the mining and export of uranium were made.

The second part of the report is expected to be released in May 1977, and approval for mining, milling, and export of uranium was anticipated.

Australia's reasonably assured uranium resources recoverable at less than $15 per pound U_3O_8, as of June 30, 1976, totaled 227,000 tons of U_3O_8, according to the Australian Atomic Energy Commission (AAEC). In the cost range of $15 to $30 per pound U_3O_8, there were 10,000 tons of reasonably assured resources and 5,000 tons of estimated resources.

The Mineral Industry of Austria

By William F. Keyes [1]

Austria made a substantial recovery in 1976 from the 1975 recession and seemed to avoid the pause that some other countries experienced late in the year. The country's close economic ties with West Germany and the linking of the schilling with the mark led to stability and a growth (5.2%) in the gross national product (GNP), surpassed in Europe only by West Germany itself. Nevertheless, the trend in output of the minerals extractive and processing industries was mixed. Iron and steel production was back up to the level of 1974 and salt and refined copper production rose, but production of domestic fuels, mine copper, and magnesite declined.

Minerals produced in Austria were in general of importance only to the domestic economy, except for magnesite, of which Austria was the largest producer among market economy countries. The need to import raw materials increased slightly by the closing at yearend of the country's only copper mine. Other developments during the year were the planning for a large new salt refinery and a decline in reserves of petroleum and natural gas.

PRODUCTION

The value of minerals extracted in Austria in 1976 was AS10.7 billion (about $600 million[2]), or slightly above that of 1975. Of this amount, about 47% represented the value of petroleum and natural gas, 32% was nonmetallic minerals including magnesite products, 10% was metallic ores, 8% was coal, and 3% was salt. There were 98 mines in operation, of which 56 were surface, including 53 quarries for nonmetallic minerals. The total ore extracted was 15.4 million tons, and 15,045 workers were employed in the extractive industries. The structure of the Austrian minerals industry is outlined in the following tabulation:

[1] Supervisory physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from the Austrian schilling (AS) to U.S. dollars at the rate of AS17.95=US$1.00.

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	Vereinigte Metallwerke Ranshofen-Berndorf AG, plant at Braunau-am-Inn, Government	87
Do	Salzburger Aluminum GmbH, plant at Lend, Salzburg	13
	Alusuisse	
Antimony	Bleibergerbergwerksunion AG, mine at Schlaining, Burgenland, Government	100
Coal	Graz-Köflacher Eisenbahn und Berbaugesellschaft, mines in Styria, Government	70
Copper	Kupferbergbau Mitterberg GmbH, mine at Mühlbach am Hochkönig, Government	100
Copper, refined	Montanwerke Brixlegg GmbH, smelter and refinery at Brixlegg, Tirol, Government	100
Iron, steel	VÖEST Alpine Montan AG (VAM) mine at Erzberg and plants at Linz and Donawitz, Government	100
Lead, zinc	Bleibergerbergkwerksunion AG, mine at Bleiberg-Kreuth, Carinthia, Government	100
Cement	Perlmooser Zementwerke AG, plants in Vienna area	50
Graphite	Graphitbergbau Kaisersberg Franz Mayr-Melnhof und Co., mine at St. Stefan/Leoben	100
Magnesite	Österr.-Amerik. Magnesit AG, mines at Radenthein and Hochfilzen, General Refractories, United States	50
Do	Veitscher Magnesitwerke AG, mine at Breitenau/Mixnitz, Magnesia AG, Switzerland	50
Petroleum	Österreichische Mineralölverwaltung AG, oil- and gasfields in Vienna Basin, Government	80
Petroleum products	Österreichische Mineralölverwaltung AG, refinery at Schwechat, Government	100
Tungsten	Wolfram Bergbau und Hüttenbetrieb GmbH, mine at Mittersill, VAM, Metallgesellschaft AG	100

Table 1.—Austria: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum, metal:			
Primary	91,554	88,848	82,670
Secondary	30,592	22,244	49,234
Antimony, mine output, metal content	540	555	564
Cadmium metal	26	30	29
Copper:			
Mine output, metal content of ore	2,687	1,983	1,175
Metal:			
Smelter	2,600	--	--
Refined including secondary	26,713	26,931	28,589
Germanium, metal content of concentrates kilograms	4,300	4,400	4,700
Iron and steel:			
Iron ore and concentrate, gross weight thousand tons	4,245	3,833	3,784
Pig iron do	3,443	3,056	3,318
Ferroalloys (electric furnace) do	6	7	8
Crude steel do	4,699	4,068	4,477
Semimanufactures do	r 3,538	3,012	3,510
Lead:			
Mine output, metal content of ore	5,785	6,101	5,393
Metal, smelter output:			
Primary	8,804	9,362	9,100
Secondary	6,808	5,779	7,609
Manganese, Mn content of domestic iron ore	80,430	72,768	70,595
Tungsten, mine output, W content	--	362	541
Zinc:			
Mine output, metal content of ore	20,977	23,040	22,651
Metal, refined	16,450	16,273	16,574
NONMETALS			
Barite	361	279	81
Cement, hydraulic thousand tons	6,435	5,630	5,880
Clays:			
Illite	387,758	382,599	297,663
Kaolin:			
Crude	312,425	281,200	270,742
Marketable	81,360	75,187	e 75,000
Other [1]	78,737	55,221	98,456
Diatomite	1,986	1,570	1,882

See footnotes at end of table.

Table 1.—Austria: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
NONMETALS—Continued				
Graphite, crude		29,550	30,586	33,057
Gypsum and anhydrite, crude	thousand tons	804	715	770
Lime	do	1,039	947	959
Magnesite:				
Crude	do	1,449	1,266	927
Sintered or dead-burned	do	547	471	401
Caustic calcined	do	157	142	125
Pigments, mineral, iron mica		9,546	8,722	10,627
Pumice (trass)		18,207	12,677	11,683
Salt:				
Rock	thousand tons	(2)	1	1
In brine:				
Evaporated	do	294	258	332
Other	do	r 241	206	245
Total	do	r 535	465	578
Sand and gravel:				
Quartz sand	do	911	825	745
Industrial sand	do	210	293	NA
Other sand and gravel	do	9,560	8,015	8,092
Stone: [3]				
Dimension stone	do	124	92	NA
Quartz and quartzite	do	100	159	205
Other quarry stone and broken stone	do	2,217	1,634	NA
Sulfur:				
Byproduct	do	24	25	26
From gypsum and anhydrite	do	26	28	23
Total	do	50	53	49
Talc and soapstone		98,440	86,512	105,649
MINERAL FUELS AND RELATED MATERIALS				
Coal, brown coal, lignite	thousand tons	3,629	3,397	3,215
Coke:				
Breeze	do	NA	342	NA
Metallurgical	do	NA	1,265	NA
Total	do	1,733	1,607	1,615
Gas, manufactured, all types [4]	million cubic feet	77,162	NA	NA
Gas, natural:				
Gross production	do	77,930	83,305	75,721
Marketed production	do	71,476	79,869	69,093
Natural gas liquids, condensate	thousand 42-gallon barrels	e r 180	182	191
Oil shale		1,470	1,360	930
Petroleum:				
Crude	thousand 42-gallon barrels	15,609	14,205	13,466
Refinery products:				
Gasoline	do	13,368	12,671	14,295
Jet fuel	do	736	620	1,135
Kerosine	do	60		96
Distillate fuel oil	do	16,205	15,656	18,345
Residual fuel oil	do	24,096	22,309	25,683
Lubricants	do	1,782	1,031	1,221
Liquefied petroleum gas	do	1,100	1,176	1,334
Bitumen	do	2,293	2,293	2,127
Other	do	2,926	3,369	3,364
Refinery fuel and losses	do	2,496	2,351	2,313
Total	do	65,062	61,476	69,913

e Estimate. p Preliminary. NA Not available.

[1] Excludes clay sand.

[2] Less than ½ unit.

[3] Excludes stone used by the cement and iron and steel industries.

[4] Includes blast furnace and coke oven gas. Manufactured gas is reported in source as gas having a caloric value of 4,200 calories per cubic meter. (1 cubic meter equals 35.3145 cubic feet).

TRADE

The mineral trade of Austria was largely with its neighbors, notably West Germany, Italy, and Yugoslavia. Unprocessed minerals imported for domestic processing included alumina from West Germany, chromite from South Africa, iron ore from Brazil, lead concentrate from a nearby producer in Italy, phosphate rock from the United States and the Soviet Union, and potash from East Germany and West Germany. Exports of Austrian products were chiefly magnesite and some steel and graphite. Tables 2 and 3 detail the mineral trade for the latest years available.

Table 2.—Austria: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Oxide and hydroxide (includes manufactured corundum)	25,565	19,954	Poland 3,952; Italy 3,839; West Germany 2,672.
Metal including alloys:			
Scrap	19,644	20,073	West Germany 9,958; Italy 7,567.
Unwrought	21,855	8,536	West Germany 7,423.
Semimanufactures	44,268	26,973	Sweden 5,258; West Germany 5,125; Switzerland 2,751.
Antimony ore and concentrate	297	329	NA.
Cadmium metal including alloys, all forms kilograms	15,200	200	NA.
Chromium:			
Chromite	50	177	Mainly to West Germany.
Oxide	7	11	Do.
Columbium and tantalum, tantalum metal including alloys, all forms kilograms	1,200	7,100	NA.
Copper:			
Ore and concentrate	948	2,236	East Germany 945; Romania 847; West Germany 443.
Copper sulfate	230	186	Italy 140; Netherlands 20; United States 18.
Metal including alloys, all forms:			
Scrap	500	622	West Germany 531.
Unwrought	10,884	10,939	West Germany 8,733; Switzerland 1,726.
Semimanufactures	11,326	6,538	West Germany 1,477; Sweden 659.
Gold metal, unworked or partly worked troy ounces	46,522	19,644	West Germany 18,326; Italy 836.
Iron and steel:			
Ore and concentrate, except roasted pyrite	1,243	1,131	Netherlands 600; West Germany 311; Belgium-Luxembourg 200.
Metal:			
Scrap	12,865	50,482	Italy 35,290; Switzerland 5,915; Czechoslovakia 5,072.
Pig iron, ferroalloys, and similar materials thousand tons	28	13	Poland 3; Hungary 2; Sweden 1; Romania 1.
Steel:			
Primary forms do	386	364	West Germany 143; Poland 140.
Semimanufactures:			
Bars, rods, shapes, angles, sections do	225	273	Italy 55; Hungary 32; West Germany 30; Yugoslavia 30.
Universals, plates, sheets do	690	967	West Germany 298; U.S.S.R. 195; United Kingdom 70; Sweden 59.
Hoop and strip do	98	78	Switzerland 18; West Germany 11; Sweden 7; Yugoslavia 7.
Rails and accessories do	70	96	Switzerland 35; Romania 14; Yugoslavia 12; East Germany 10.
Wire do	68	40	Hungary 8; Switzerland 7; West Germany 5; Yugoslavia 5.
Tubes, pipes, fittings do	189	154	United Kingdom 25; Poland 23; Sweden 23; West Germany 22.
Castings and forgings, rough do	9	8	Switzerland 1; United States 1; Sweden 1.

See footnotes at end of table.

Table 2.—Austria: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Lead:			
Oxide	1,644	3,023	Czechoslovakia 1,240; Hungary 934; Yugoslavia 749.
Metal including alloys, all forms	1,514	1,042	Yugoslavia 564.
Magnesium metal including alloys, all forms	1,247	238	NA.
Manganese oxide	381	473	Brazil 453.
Mercury ---76-pound flasks	16	380	Mainly to West Germany.
Molybdenum metal including alloys, all forms	706	569	NA.
Nickel metal including alloys, all forms	983	181	Netherlands 156.
Platinum-group metals and silver metal, including alloys, all forms:			
Platinum-group ---troy ounces	8,584	41,442	West Germany 38,324; Poland 1,511.
Silver:			
Bullion ---do	[1] 511	386	Mainly to West Germany.
Other (powder) ---do	[1] 10	--	
Semimanufactures ---do	[1] 167	322	Mainly to Yugoslavia.
Tin:			
Oxide	6	31	Mainly to Bulgaria.
Metal including alloys, all forms	61	42	Denmark 31; West Germany 7; Yugoslavia 4.
Titanium oxide	356	14	Mainly to Switzerland.
Tungsten:			
Ore and concentrate	20	30	All to East Germany.
Metal including alloys, all forms	177	150	NA.
Zinc:			
Ore and concentrate	5,085	4,632	Italy 3,658; West Germany 974.
Oxide	404	416	Hungary 120; Netherlands 112; West Germany 62.
Metal including alloys, all forms	1,028	364	West Germany 233; Italy 71.
Other:			
Ore and concentrate	260	417	United Kingdom 230; France 112; West Germany 76.
Ash and residue containing nonferrous metals	45,289	40,325	Italy 24,577; West Germany 12,941.
Waste and sweepings of precious metals ---kilograms	14,111	30,475	West Germany 29,589.
Oxides, hydroxides, and peroxides of metals, n.e.s	58	443	Italy 294; Sweden 58; West Germany 46.
Base metals including alloys, all forms, n.e.s	3,490	1,566	United Kingdom 573; United States 546; Italy 392.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, other natural abrasives	2	1	NA.
Grinding and polishing wheels and stones	11,867	11,625	Poland 1,475; Sweden 1,182; West Germany 1,180.
Asbestos	131	183	West Germany 159.
Cement	341,525	29,931	West Germany 14,774; Yugoslavia 13,437.
Chalk	2,386	3,042	Hungary 1,202; Yugoslavia 679; Italy 539.
Clays and clay products (including all refractory brick):			
Crude clays:			
Kaolin (china clay)	26,648	13,188	Italy 8,260; Yugoslavia 2,293; Poland 1,325.
Other	1,356	356	West Germany 94; Hungary 85; Czechoslovakia 57.
Products:			
Refractory (including nonclay bricks)	287,368	272,624	France 41,382; West Germany 36,879.
Nonrefractory	1,764	1,931	Switzerland 613.
Diamond, industrial ---value	$27,657	--	
Diatomite and other infusorial earth	313	729	Yugoslavia 439; Czechoslovakia 202.
Feldspar	80	100	All to Czechoslovakia.
Fertilizer materials:			
Crude, unspecified	3	23,061	Czechoslovakia 16,020; Hungary 7,011.
Manufactured, phosphatic	157,777	166,785	Hungary 81,236; Czechoslovakia 46,047; U.S.S.R. 35,856.
Graphite, natural	16,914	15,500	Poland 7,710; West Germany 4,549; Italy 1,235.
Gypsum and plasters	135,251	127,557	West Germany 109,811; Switzerland 11,870.

See footnotes at end of table.

Table 2.—Austria: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Lime	40,353	16,122	Hungary 10,160; Czechoslovakia 4,395.
Magnesite	149,019	125,183	West Germany 32,458; United States 12,424; Hungary 11,171.
Mica, all forms	36	43	Yugoslavia 15; Poland 14; Hungary 4; Republic of South Africa 4.
Pigments, mineral, including processed iron oxides	5,983	5,533	West Germany 1,557; United Kingdom 1,254.
Precious and semiprecious stones, including diamond:			
Natural ---kilograms	1,436	1,589	NA.
Manufactured ---do	1,242	1,339	NA.
Salt	16	16	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous including marble and limestone	74,835	70,795	West Germany 62,491; Switzerland 8,297.
Slate	11	58	All to Switzerland.
Other	50,281	60,307	West Germany 59,014.
Worked:			
Paving and flagstone	7,902	4,615	Switzerland 3,441; West Germany 917.
Slate	2	11	NA.
Other	1,963	2,746	West Germany 2,238; United States 237.
Dolomite	5,376	3,145	West Germany 1,052; Finland 508; Yugoslavia 488.
Gravel and crushed rock	547,414	365,855	Switzerland 255,407; West Germany 104,952.
Limestone	--	19	NA.
Quartz and quartzite	327	1,108	West Germany 750; Yugoslavia 205; Czechoslovakia 121.
Sand, excluding metal bearing	124,872	105,920	West Germany 52,608; Switzerland 43,268.
Sulfuric acid and oleum	555	1,338	Italy 1,028; West Germany 267.
Talc, steatite, soapstone, pyrophyllite	84,495	72,732	West Germany 35,302; Italy 9,239; Netherlands 6,040.
Other nonmetals, n.e.s.:			
Crude	5,137	4,563	West Germany 3,619; Yugoslavia 469.
Slag, dross, and similar waste, not metal bearing	39,168	44,093	West Germany 35,424; Italy 8,648.
Oxides and hydroxides of strontium, barium, magnesium	67	51	Italy 30.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen natural	2	23	NA.
Carbon black and gas carbon	11	43	West Germany 23.
Coal:			
Anthracite and bituminous including briquets	5	18	NA.
Lignite and lignite briquets	8,988	9,994	West Germany 9,991.
Coke and semicoke	27,217	13,415	Romania 13,001.
Gas, manufactured ---thousand tons	21	34	Czechoslovakia 30; West Germany 3.
Hydrogen, helium, rare gases thousand cubic feet	12,908	10,303	West Germany 4,865; Hungary 1,682; Bulgaria 1,474.
Peat, including peat briquets and litter	74	15	NA.
Petroleum refinery products:			
Gasoline, aviation and motor thousand 42-gallon barrels	62	44	All to Poland.
Kerosine and jet fuel ---do	(2)	(2)	NA.
Distillate fuel oil ---do	300	77	All to Czechoslovakia.
Residual fuel oil ---do	74	122	Czechoslovakia 70; Poland 51.
Lubricants ---do	1,000	647	Poland 262; Czechoslovakia 254.
Other ---do	62	52	Poland 6; Czechoslovakia 5.
Total ---do	1,498	942	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	16,445	14,317	West Germany 8,170; Yugoslavia 2,900.

NA Not available.
[1] Reported in thousand troy ounces in 1975.
[2] Less than ½ unit.

Table 3.—Austria: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite	32,298	18,947	Australia 7,670; Surinam 6,955; Guyana 1,391.
Oxide and hydroxide	231,346	201,277	West Germany 9,523; France 2,483.
Metal including alloys:			
Scrap	(1)	14,120	Poland 6,683; U.S.S.R. 4,673; Czechoslovakia 1,766.
Unwrought	[2] 35,570	17,994	Hungary 5,259; Norway 4,902; West Germany 4,033.
Semimanufactures	20,620	17,091	West Germany 8,188; Switzerland 4,272.
Antimony:			
Ore and concentrate	405	154	NA.
Metal including alloys, all forms	48	97	Belgium-Luxembourg 82.
Arsenic trioxide, pentoxide, acids	47	43	All from France.
Cadmium metal including alloys, all forms	8	1	NA.
Chromium:			
Chromite	114,435	123,138	Republic of South Africa 45,334; Turkey 22,327; Philippines 19,957.
Oxide and hydroxide	474	294	West Germany 146; People's Republic of China 50; Poland 37.
Cobalt oxide and hydroxide, kilograms	3,300	500	NA.
Columbium and tantalum. Tantalum metal including alloys, all forms, do	14,000	15,900	West Germany 7,100; United States 1,200; Netherlands 500.
Copper:			
Ore and concentrate	108	22	Belgium-Luxembourg 7.
Copper sulfate	163	148	Belgium-Luxembourg 50; France 45; West Germany 30; Switzerland 17.
Metal including alloys:			
Scrap	8,937	11,904	West Germany 6,143; Switzerland 2,537; Poland 1,885.
Unwrought	34,569	25,019	West Germany 10,002; Zambia 2,635; Chile 2,567.
Semimanufactures	16,633	16,377	West Germany 6,788; United Kingdom 3,918; Sweden 2,370.
Gold metal, unworked or partly worked, thousand troy ounces	2,129	292	Switzerland 84; Republic of South Africa 80; U.S.S.R. 44.
Iron and steel:			
Ore and concentrate, except roasted pyrite, thousand tons	2,800	2,578	Brazil 1,473; U.S.S.R. 716; Liberia 229.
Roasted pyrite, do	211	181	Italy 148; West Germany 13.
Metal:			
Scrap, do	88	33	Poland 16; West Germany 8; Czechoslovakia 6.
Pig iron, including cast iron and similar materials [3], do	87	52	U.S.S.R. 17; Hungary 17; West Germany 9.
Ferroalloys:			
Ferromanganese, do	24	21	Norway 15; West Germany 2; Republic of South Africa 2.
Other, do	35	40	Yugoslavia 6; Norway 6; Republic of South Africa 6; U.S.S.R. 4; Greece 4.
Steel:			
Primary forms, do	153	84	West Germany 45; Hungary 16.
Semimanufactures:			
Bars, rods, angles, shapes, sections, do	180	118	West Germany 68; Italy 21; Switzerland 19.
Universals, plates, sheets, do	126	110	West Germany 63; Belgium-Luxembourg 12.
Hoop and strip, do	32	22	West Germany 15; Sweden 2; Switzerland 2.
Rails and accessories, do	4	6	Poland 4; West Germany 2.
Wire, do	15	14	West Germany 4; Belgium-Luxembourg 3; Sweden 1.
Tubes, pipes, fittings, do	159	139	West Germany 84; Italy 11.
Castings and forgings, rough, do	10	8	West Germany 6; Yugoslavia 1.

See footnotes at end of table.

Table 3.—Austria: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Lead:			
Ore and concentrate	5,116	7,424	Italy 6,415; West Germany 1,009.
Oxide	280	90	Switzerland 70; West Germany 20.
Metal including alloys:			
Scrap	(1)	1,608	Switzerland 1,248.
Unwrought	r 2 21,332	15,909	Yugoslavia 10,521; Italy 1,755.
Semimanufactures	189	243	Mainly from West Germany.
Magnesium metal including alloys, all forms	1,705	1,067	Czechoslovakia 857; Norway 107.
Manganese:			
Ore and concentrate	898	479	Morocco 250; West Germany 159; Netherlands 70.
Oxide	131	198	United States 151; Belgium-Luxembourg 41.
Mercury ----76-pound flasks	951	1,790	U.S.S.R. 1,070; United States 252; Italy 203.
Molybdenum:			
Oxide	1,351	688	NA.
Metal including alloys, all forms	21	570	West Germany 8.
Nickel:			
Matte, speiss, similar materials	1,444	904	Cuba 381; United States 296.
Metal including alloys:			
Scrap	(1)	1,056	U.S.S.R. 969.
Unwrought	2 2,751	1,904	Australia 514; United Kingdom 464; Canada 12.
Semimanufactures	1,445	820	West Germany 541; United Kingdom 139.
Platinum-group metals and silver metal including alloys, all forms:			
Platinum group ----troy ounces	25,270	26,331	West Germany 11,896; United Kingdom 7,652; United States 4,438.
Silver:			
Bullion ----thousand troy ounces	6,668	5,343	United Kingdom 2,234; United States 1,296; West Germany 759.
Other (powder) ----do	39	3	All from West Germany.
Semimanufactures ----do	1,389	8,144	West Germany 4,469; Switzerland 2,984; United Kingdom 685.
Tin metal including alloys, all forms	665	479	West Germany 213; Indonesia 83; Malaysia 57.
Titanium oxide	9,536	7,228	West Germany 3,595; Finland 1,137; Italy 703.
Tungsten:			
Ore and concentrate	1,996	1,717	People's Republic of China 735; Australia 490.
Oxide and hydroxide	430	204	NA.
Metal including alloys, all forms	61	196	United States 99; West Germany 66.
Zinc:			
Ore and concentrate	373	128	Yugoslavia 115; West Germany 13.
Oxide	884	504	West Germany 419.
Metal including alloys:			
Scrap and blue powder	890	550	United Kingdom 183; West Germany 142; Yugoslavia 60.
Unwrought	9,371	7,571	West Germany 2,870; Italy 1,516; Poland 920; Bulgaria 918.
Semimanufactures	1,279	922	West Germany 707; Belgium-Luxembourg 73.
Other:			
Ore and concentrate	10,260	8,504	United States 2,429; Canada 2,164; Australia 1,390; Chile 1,251.
Ash and residue containing nonferrous metals	65,594	69,131	U.S.S.R. 24,842; East Germany 15,752; Poland 11,116; Hungary 8,192.
Waste and sweepings of precious metals kilograms	1,894	147	Yugoslavia 120; Denmark 17.
Oxides, hydroxides, and peroxides of metals, n.e.s	1,414	1,493	United States 727; Republic of South Africa 468; West Germany 189.
Base metals including alloys, all forms, n.e.s	4,607	4,030	U.S.S.R. 3,268; Belgium-Luxembourg 218.

See footnotes at end of table.

Table 3.—Austria: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, other natural abrasives	888	602	West Germany 402; Italy 119.
Dust and powder of precious and semiprecious stones (including diamond) kilograms	41	27	United States 19; Switzerland 6.
Grinding and polishing wheels and stones	852	837	West Germany 394; Belgium-Luxembourg 148; Italy 114.
Asbestos	33,067	34,343	Canada 10,859; U.S.S.R. 10,061; Republic of South Africa 7,155.
Barite and witherite	3,082	3,288	West Germany 2,832; Czechoslovakia 413.
Boron materials:			
Crude natural borates	12,361	10,630	United States 7,092; Turkey 3,506.
Oxide and acid	1,119	1,465	Turkey 532; France 456; United States 329.
Cement	63,650	50,582	West Germany 23,163; Italy 6,850; Belgium-Luxembourg 5,866.
Chalk	9,386	5,985	France 4,755; West Germany 955.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Bentonite	792	629	West Germany 271; United States 200; Italy 141.
Kaolin (china clay)	95,837	73,043	Czechoslovakia 25,247; West Germany 20,656; United Kingdom 20,340.
Other	105,848	90,125	West Germany 45,381; Czechoslovakia 33,879.
Products:			
Refractory (including nonclay bricks)	12,192	23,209	West Germany 18,735.
Nonrefractory	198,835	192,602	Italy 100,894; West Germany 64,130.
Cryolite and chiolite, natural	322	269	Denmark 259.
Diamond, industrial value	$6,580	$33,984	Republic of South Africa $13,490; West Germany $9,529.
Diatomite and other infusorial earth	6,741	5,675	Hungary 2,468; United States 1,054; Denmark 550.
Feldspar	9,776	6,488	Sweden 2,718; West Germany 2,038; Italy 1,337.
Fertilizer:			
Crude:			
Phosphatic	611,983	408,316	U.S.S.R. 138,052; United States 100,493; Israel 78,684.
Potassic	39,746	19,256	East Germany 11,689; West Germany 7,567.
Other	1,677	1,251	West Germany 1,108; France 73.
Manufactured:			
Nitrogenous	12,895	6,781	Czechoslovakia 3,840; West Germany 2,325.
Phosphatic	217,855	91,254	France 46,880; Belgium-Luxembourg 38,086.
Potassic	356,929	58,526	West Germany 11,533.
Other including mixed	4,775	3,590	West Germany 2,608; Belgium-Luxembourg 512.
Fluorspar	14,395	14,533	East Germany 8,070; West Germany 5,458.
Graphite, natural	286	796	North Korea 509; West Germany 263.
Gypsum and plasters	24,937	8,146	West Germany 3,814; Switzerland 3,117.
Lime	785	613	Mainly from West Germany.
Magnesite	98,061	109,232	Turkey 52,696; Greece 20,854; Israel 10,357.
Mica:			
Crude including splittings and waste	285	257	Norway 145; West Germany 82.
Worked including agglomerated splittings	85	91	Switzerland 26; West Germany 12.
Pigments, mineral:			
Natural, crude	142	159	France 99; West Germany 24.
Iron oxides, processed	r 3,100	2,351	All from West Germany.

See footnotes at end of table.

Table 3.—Austria: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Precious and semiprecious stones including diamond:			
Natural, crude ---------thousand carats--	138,615	94,980	West Germany 49,910; Brazil 18,535; Malagasy Republic 17,400.
Manufactured ----------do----	36,945	28,695	Switzerland 20,430; France 7,750.
Pyrite (gross weight) ----------	13,383	13,558	U.S.S.R. 7,217; Italy 6,242.
Salt including brine ----------	8,601	460	West Germany 343; France 110.
Sand and gravel:			
Gravel (including crushed rock) --------	152,251	173,087	West Germany 155,416; Italy 16,607.
Sand excluding metal bearing ----------	320,816	306,747	West Germany 213,434; Czechoslovakia 72,807.
Stone, n.e.s.:			
Dimension stone:			
Crude and partly worked:			
Calcareous including marble and limestone ----------	10,199	9,163	Italy 6,311; West Germany 1,600.
Slate ----------	2,051	2,293	France 875; Norway 544; Sweden 344.
Other ----------	31,943	28,187	Italy 16,074; Republic of South Africa 5,076.
Worked:			
Paving and flagstone ----------	11,376	9,924	Italy 3,740; Yugoslavia 2,611; Romania 1,573; West Germany 1,403.
Slate ----------	740	506	Italy 165; France 138; Sweden 67; West Germany 54.
Dolomite, chiefly refractory grade --------	5,696	4,582	Italy 2,499; Norway 774; West Germany 727; France 536.
Limestone, except dimension ----------	7,605	566	Mainly from West Germany.
Quartz and quartzite ----------	24,256	19,586	West Germany 15,186; Hungary 3,000.
Volcanic material (trass) ----------	910	726	West Germany 617.
Sulfur:			
Elemental, all forms ----------	154,063	112,356	Poland 72,613; West Germany 21,303; U.S.S.R. 15,784.
Sulfur dioxide ----------	2,316	2,830	West Germany 2,283; Switzerland 324.
Sulfuric acid and oleum ----------	35,331	21,320	Poland 18,773; West Germany 1,229.
Talc, steatite, soapstone, pyrophyllite -------	2,109	1,141	Norway 597; Italy 231; Belgium-Luxembourg 189.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet ----------	2	4	NA.
Other ----------	50,575	47,897	West Germany 25,139; Hungary 15,094.
Slag, dross, and similar waste, not metal bearing ----------	29,511	31,980	Italy 17,571; Republic of South Africa 8,323; West Germany 2,317.
Oxides and hydroxides of magnesium, strontium, barium ----------	744	508	West Germany 406; Norway 92.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural ----------	850	571	Tobago 476; West Germany 70.
Carbon black and gas carbon ----------	23,812	20,866	West Germany 12,132; Italy 7,058.
Coal:			
Anthracite and bituminous including briquets ----------thousand tons--	2,941	259	Poland 93; U.S.S.R. 72; Czechoslavakia 65.
Lignite and lignite briquets ------do----	921	675	Yugoslavia 228; East Germany 177; West Germany 27.
Coke and semicoke ----------do----	1,215	989	Czechoslovakia 546; Poland 250; West Germany 85.
Gas, natural ----------do----	1,593	1,440	U.S.S.R. 1,408; West Germany 19.
Hydrogen, helium, rare gases thousand cubic feet--	72,093	49,018	West Germany 48,514.
Peat including peat briquets and litter -----	35,924	36,479	West Germany 17,497; U.S.S.R. 8,220; Poland 6,830.

See footnotes at end of table.

Table 3.—Austria: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum:			
Crude and partly refined:			
Crude --thousand 42-gallon barrels--	47,389	42,567	Iraq 19,971; U.S.S.R. 7,833; Libya 6,692; Iran 4,046.
Partly refined ----------do----	291	NA	
Refinery products:			
Gasoline, aviation and motor --do----	5,414	6,426	Italy 2,304; West Germany 2,236; Czechoslovakia 663.
Kerosine ----------do----	8	11	West Germany 4; Italy 3; Netherlands 2.
Distillate fuel oil ----------do----	826	903	West Germany 380; Italy 231; East Germany 157; U.S.S.R. 104.
Residual fuel oil ----------do----	8,507	7,726	West Germany 2,624; Italy 1,325; Poland 1,139; Hungary 919.
Lubricants ----------do----	857	866	Hungary 233; Poland 113; Italy 113; West Germany 113.
Mineral jelly and wax --------do----	107	87	West Germany 47; East Germany 16; Hungary 8.
Other ----------do----	2,096	286	West Germany 70; Belgium-Luxembourg 53.
Total ----------do----	17,815	16,305	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ----------	9,215	10,349	West Germany 3,332; Netherlands 2,692; Czechoslovakia 1,157.

r Revised. NA Not available.
1 Included with unwrought for 1974.
2 Includes scrap.
3 Includes spiegeleisen, powder, sponge, and shot.

COMMODITY REVIEW

METALS

Aluminum.—Production of aluminum declined for the second year in a row, as the export market fell away. Imports continued unchanged, as Ranshofen-Berndorf AG imported from its new subsidiary in Hamburg, West Germany.

Capacities of the two producers also remained unchanged: Salzburger Aluminium GmbH at Lend, 12,000 tons per year; and Vereinigte Metallwerke Ranshofen-Berndorf AG at Ranshofen, 80,000 tons per year.

Antimony.—The small antimony mine at Schlaining, Burgenland, after finishing equipping the new Vinzenz shaft, continued normal operation, but the grade of ore mined dropped from 3.17% antimony in 1975 to 3.04% in 1976. The mine, operated by Bleibergerbergwerksunion AG, also maintained its moderate reserves of ore by adequate exploration.

Copper.—Austria's only copper mine, at Mühlbach am Hochkönig, Salzburg Province, was closed late in 1976 after 40 years of modern operation; production by Kupferbergbau Mitterberg GmbH had become uneconomic at the current price of copper. Recently the mine had been producing only about 100,000 tons annually of ore averaging 1.3% copper, but production had reached a maximum of almost 200,000 tons in 1973. Operation of the copper smelter-refinery at Brixlegg, Tirol, was not affected, since the mine provided only about 4% of the copper refined there.

Iron Ore.—There were three iron ore mines in Austria; all are owned by the Government's VÖEST Alpine Montan AG (VAM), and production chiefly supplies the steelworks at Donawitz. Production at all three mines declined slightly (about 1%) in 1976, and only about one-third of Austria's consumption of iron ore was supplied by domestic mines.

The largest mine, Erzberg, which furnished 89% of the total production, and the small Radmer mine are both located northwest of Leoben. The third mine,

Hüttenberg, is located in Carinthia, north of Klagenfurt, and was expected to close around 1980; other deposits in the area, such as Waitschach, are considered uneconomic, and concern was expressed over effects on local employment of the expected closing.

Iron and Steel.—In 1976, steel production increased over the low output of 1975, as business conditions generally improved. In the period 1976–80 iron and steel producers planned to spend AS20 billion (about US$1.2 billion) to complete investment projects expanding metallurgical processing and finished steel capacity. According to the Chairman of the Board of Directors of VAM Austria should not attempt to expand its industry in order to hold its share of world production, because the country lacks resources to produce steel at low cost; two-thirds of its ore and all its coking coal are imported. Instead the country should concentrate on finished steel products, especially high-grade special steel, expand the use of the LD (basic oxygen) process, and establish stable relationships with new producers such as Brazil, Mexico, and Venezuela to obtain basic steel products.

VAM continued as the dominant steel producer in Austria, with major plants at Linz and Donawitz. The company had originally taken a small participation in the Saldanha Bay steel mill project in the Republic of South Africa, expecting to receive some 400,000 tons annually for 20 years. However, South Africa postponed the project; Austrian industry representatives ascribed the postponement to unfavorable economic and political developments.

Lead and Zinc.—The Bleiberg-Kreuth mine of Bleibergerbergwerksunion AG, located near the Italian border, increased production at the cost of some decline in ore grade, from 1.61% lead in 1975 to 1.33% in 1976 and from 6.06% to 5.63% zinc in the same period; most of the increased ore output came from the Bleiberg section. Exploration continued in the Erlach area west of the mine, and prospecting and sampling covered a wide area in the Alps near the mine and along the Yugoslav border.

Tungsten.—Mining of scheelite ore at the Mittersill mine of Wolfram GmbH (subsidiary of VAM, Metallgesellschaft, and Teledyne of the United States) increased greatly in 1976, the first full year of operation. As in 1975, a large part of the production (1,800 tons of WO_3) went into building up stocks; WO_3 content of the concentrate was less than 700 tons. Output was apparently due to reach 1,000 to 1,200 tons of tungsten, not WO_3 as earlier reported.

The processing and refining plant for the concentrate at Bergla, south of Graz and near the Yugoslav border, came into production at yearend 1976 or early in 1977. Plant capacity was reportedly about 1,350 tons per year of tungsten contained in blue oxide, tungsten powder, and tungsten carbide powder.

NONMETALS

Graphite.—About 60% of Austrian graphite production came from the Kaisersberg mine at St. Stefan ob Leoben and the Trieben mine at Hohenstauern, both operated by Graphitbergbau Kaisersberg Franz Mayr-Melnof und Co. The remainder represented graphite recovered from old tailings at two locations in Lower Austria and one in Styria.

Magnesite.—Poor export demand caused a drop of over 25% in the total production of the six magnesite mines; all mines registered declines in production. The mines were operated by the Veitscher Magnesitwerke AG (Breitenau and Hohenstauern mines), the Steirische Magnesit Industrie AG, a subsidiary of Veitscher (Oberdorf mine), and the Österreichisch-Amerikanische Magnesit AG (Hochfilzen, Radenthein, and Tux mines). Radenthein changed mining methods during the year, from top slicing to block caving.

Salt.—The Austrian state salt monopoly, Österreichische Salinen, planned to build, by 1980, a new salt-evaporating plant at Steinkogel near Ebensee. Production would be at the rate of 400,000 tons of salt per year. The additional brine was to come from expansion of the mines and boreholes at Altaussee, Hallstatt, and Bad Ischl; another mining area was at Dürrnberg, near Hallein; all areas were in Upper Austria, Salzburg, and Styria Provinces. The brine product, of which one-third has been obtained from boreholes in recent years, was pumped to plants at Ebensee, Bad Aussee, and Hallein.

MINERAL FUELS

Energy.—Over one-third of Austria's supply of energy came from domestic sources in 1975. These were fairly well distributed among hydroelectric energy, natural gas, and petroleum, with minor additional amounts of coal and appreciable fuelwood. Imports of energy were in the form of petroleum from the Middle East and the U.S.S.R. and natural gas from the U.S.S.R. The energy balances for 1974 and 1975 are presented in table 4.

Coal and Coke.—Interest continued on the part of VAM in purchasing a U.S. coal mine to assure itself of a steady source of metallurgical coal. In 1975–76, about 90% of all Austrian imports of solid fuels came from Eastern Europe, and the company was interested in diversifying its sources of supply.

Domestic production of coal and employment in the coal mining industry continued the declining trend of the last two decades. Of the four coal mining areas, only one, the Trimmelkam brown coal mine of Salzach Kohlenbergbau GmbH, in Upper Austria near the West Germany border, was able to increase production. Exploration was conducted also for further coal seams north of the mine in the area between St. Radegrund and Mattighofen. Production dropped at the Fohnsdorf glanzkohle mine in Upper Styria; it also dropped at Voitsberg-Köflach in western Styria, the largest brown coal mining area; and in the second-ranking brown coal area, Wolfsegg-Trauenthal. The only mine in the former western Styria brown coal district, Pölfing-Bergla, was closed at the end of 1975. One glanzkohle district (Fohnsdorf mine) and three brown coal districts (Voitsberg-Köflach, Wolfsegg-Trauenthal, and Salzach, or Trimmelkam) remained in operation.

Petroleum and Natural Gas.—There were eight minor discoveries of hydrocarbons in the Vienna Basin during the year, of which two were of oil. Intense exploration continued, including stratigraphic wells and seismic surveys, to clarify the structure of the Tertiary Basin to a depth of 2,000 meters. In the Molasse Basin to the west, a less important producing area, three small discoveries were made in structural-stratigraphic traps. All exploration activity was by the Austrian State oil company Österreichische Mineralölverwaltung AG (OMV) and the Shell-Mobil subsidiary, Rohöl-Aufsuchungs AG (RAG).

Consumption of petroleum and natural gas increased sharply in 1976, as a result of a dry summer and lessened hydroelectric production, but domestic production of both hydrocarbons declined by about 1%. Production of petroleum peaked in 1955 at about 3.7 million tons, well above domestic consumption at that time, but had declined almost 50% to 1.9 million tons

Table 4.—Austria: Supply and apparent consumption of fuels and power for 1974 and 1975

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood	Hydroelectric power
1974:						
Production	11.7	1.8	3.3	2.9	0.9	2.8
Imports	20.6	4.5	12.5	3.1	.1	.4
Exports	.9	r --	.1	--	--	.8
Apparent consumption	[2] 31.4	6.3	15.7	6.0	1.0	2.4
1975:						
Production	11.8	1.7	3.0	3.3	.9	[3] 2.9
Imports	19.4	3.9	12.6	2.5	--	.4
Exports	1.0	--	.2	--	--	.8
Apparent consumption	[2] 30.2	5.6	15.4	5.8	.9	2.5

r Revised.
[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Includes refinery and other losses and nonfuel uses.
[3] Calculated at 1,000 kilowatt hours = 0.123 SCE, which understates the utility of hydroelectric power.

Sources: 1974: Adapted from World Energy Supplies, 1950–1974, United Nations Statistical Paper, ser. J, No. 19; 1975: Energy Statistics, Organization for Economic Cooperation and Development, Paris, 1976, 241 pp.

by 1976; almost all was produced by OMV and RAG, with the Canadian company Richard K. van Sickle contributing a negligible amount. Oil reserves fell to 23.2 million tons at yearend 1976, a decline of 9% from 1975 reserves; natural gas reserves were estimated at 14.9 billion cubic meters as of the same date, a decrease of 5% from the 1975 reserves.

Austria's only petroleum refinery in 1976 —at Schwechat, near Vienna, owned by OMV—was being expanded by 40,000 barrels to a capacity of 320,000 barrels per stream-day. However, throughput during 1976 averaged only about 180,000 barrels per day. Most of the crude was imported through a 260-mile branch of the Transalpine pipeline from Trieste, Italy. A twin 100-mile products line ran from the refinery west to a terminal near Linz.

Uranium.—Investigation continued of the uranium occurrences in the Mitterberg copper mine; the mine, however, was inactivated at yearend. A drilling and sampling program for uranium was to be carried out in the Ruperti section at a cost of AS14 million ($800,000).

Development continued at the Pongau mine of Pryssok und Co. near Forstau (Schladming), and surface drilling was planned near Tweng, Weisspriach, and Faningberg to the south.

The Mineral Industry of Belgium and Luxembourg

By William F. Keyes [1]

After the recession of 1975, the Belgian economy revived during the first half of 1976, only to decline again in the second half. The metalworking industry benefited from the initial strong demand in industries such as automobiles and construction, but orders declined as the year progressed. Private investment continued low in 1976, partly discouraged by low-capacity utilization, which was below 70% in metals production. Belgian industry has, in recent years, fallen behind in investment in new technology, and the Belgian Government was impelled to propose various new fiscal incentives during the year.

Belgium was an important processor of nonferrous metals and a significant producer of crude steel in 1976. Coal production was moderate, but production declines of recent decades may have been halted. The country is also an important petroleum refiner, producing products largely for its own consumption.

During 1976, the Belgian steel industry was consolidated, copper and lead-zinc treatment facilities were expanded, and a major expansion of petroleum-refining capacity was completed. The Luxembourg steel industry suffered during the economic slowdown and struggled to maintain employment at existing levels.

BELGIUM

PRODUCTION

The extractive production index declined again in 1976 to 67.5 compared with 70 in 1975. Only the coal production index declined, however; the production index of the lower valued nonmetallic minerals increased slightly. Processing industries also registered small gains; the steel production index rose from 88.2 to 95.9 and the nonferrous metals index, from 105.4 to 129.5 (1970=100). Major producers of minerals in Belgium in 1976 are listed in the following tabulation:

[1] Supervisory physical scientist, International Data and Analysis.

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Cement	S.A. Ciments d'Obourg, plant at Obourg	33
Do	S.A. Cimenteries C.B.R. Cementbedrijven N.V., plant at Lixhe, Société Générale de Belgique (SGB)	31
Coal	N.V. Kempense Steenkolenmijnen, mines in Limburg Province	65
Copper, refined	Métallurgie Hoboken-Overpelt N.V. S.A., smelter at Antwerp-Hoboken, electrolytic refinery at Olen, SGB	90
Iron and steel	S.A. Cockerill-Ougrée Providence et Espérance-Longdoz, plants near Liège, SGB	40
Do	Sté. Métallurgique Hainaut-Sambre S.A., plants near Charleroi-Marcinelle, Frère group	20
Do	S.A. Forges de Thy-Marcinelle et Monceau, plant at Charleroi-Marcinelle, Frère group	10
Do	Maritieme Staalnijverheid N. V., also called Sidérurgie Maritime S.A. (SIDMAR), plant at Ghent-Zelzate	15
	Aciéries Réunies de Burbach-Eich-Dudelange S.A. (ARBED), Luxembourg	--
Lead	Métallurgie Hoboken-Overpelt N.V. S.A., smelter at Antwerp-Hoboken, SGB	80
Petroleum products	Société Industrielle Belge des Pétroles S.A., refinery at Antwerp, British Petroleum, United Kingdom	36
Do	S.A. Texaco Belgium N.V., refinery at Ghent	19
Do	S.A. Chevron Oil Belgium, refinery at Feluy	15
Zinc	Métallurgie Hoboken-Overpelt N.V. S.A., electrolytic refinery at Overpelt, SGB	30
Do	Société des Mines et Fonderies de Zinc de la Vieille-Montagne, S.A., electrolytic refinery at Balen, SGB	50

Table 1.—Belgium: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum metal, secondary only	5,900	2,700	2,600
Cadmium	1,044	972	1,200
Copper:			
Blister [e]	16,000	11,000	6,000
Refined including alloys	388,308	357,024	481,788
Iron and steel:			
Iron ore and concentrate thousand tons	123	93	63
Pig iron do	13,021	9,082	9,877
Ferroalloys do	131	98	84
Steel:			
Crude do	16,224	11,583	12,145
Semimanufactures do	13,245	9,151	9,588
Lead metal:			
Primary	99,600	103,000	109,500
Secondary	10,008	11,948	12,024
Total	109,608	114,948	121,524
Tin metal:			
Primary	3,418	4,562	4,068
Secondary	818	958	1,992
Total	4,236	5,520	6,060
Zinc metal:			
Primary	288,868	218,264	235,948
Secondary (remelted zinc)	4,700	6,700	5,300
Total	293,568	224,964	241,248
Other nonferrous metals:			
Precious metals, unworked, not further specified [2] thousand troy ounces	36,332	30,046	30,637
Base metals, unspecified [3]	5,236	5,484	6,004
NONMETALS			
Cement, hydraulic thousand tons	7,467	6,884	7,504
Clays, n.e.s do	240	116	107
Fertilizer materials, manufactured:			
Nitrogenous, nitrogen content do	430	397	399
Phosphatic, gross weight:			
Thomas slag do	1,350	1,019	e 852
Superphosphatic, ordinary do	253	126	175
Other do	551	509	398
Gypsum and anhydrite, calcined	102,204	221,268	219,708

See footnotes at end of table.

Table 1.—Belgium: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
NONMETALS—Continued			
Lime and dead-burned dolomite:			
Quicklime ---thousand tons--	3,228	2,520	2,304
Dead-burned dolomite ---do---	330	234	209
Sodium and sodium compounds, n.e.s., sodium carbonate	359,100	367,044	351,456
Stone, sand and gravel:			
Calcareous:			
Dolomite ---thousand tons--	2,588	2,477	2,685
Limestone ---do---	23,784	22,860	24,156
Marble:			
In blocks ---cubic meters--	2,652	2,328	2,340
Crushed and other	9,876	2,844	4,944
Petit granite (Belgium bluestone):			
Quarried ---cubic meters--	361,476	407,556	739,800
Sawed ---do---	70,860	67,824	67,944
Worked ---do---	11,796	10,464	9,336
Crushed and other ---do---	346,968	537,612	626,916
Porphyry, all types ---thousand tons--	5,486	5,436	6,289
Quartzite	[r] 440,292	372,289	311,422
Sandstone:			
Rough stone including crushed ---thousand tons--	2,300	2,107	2,267
Paving and mosaic stone	552	408	894
Other	48,660	44,076	40,773
Slate, roofing and other ---thousand tons--	[r] 1,982	[4] 1,416	NA
Sand and gravel:			
Construction sand ---do---	11,484	10,248	9,744
Foundry sand ---do---	1,416	1,032	1,044
Dredged sand ---do---	941	860	1,236
Glass sand ---do---	1,920	1,608	1,620
Other sand ---do---	2,892	2,532	2,244
Gravel (dredged) ---do---	6,336	5,916	6,912
Sulfur, byproduct:			
Elemental ---do---	26	24	60
Other forms ---do---	197	172	183
Total ---do---	223	196	243
MINERAL FUELS AND RELATED MATERIALS			
Carbon black [e]	2,000	2,000	2,000
Coal:			
Anthracite ---thousand tons--	2,038	1,507	1,126
Bituminous ---do---	6,073	5,972	6,112
Total ---do---	8,111	7,479	7,238
Coke, all types ---do---	8,052	5,724	6,216
Fuel briquets, all kinds ---do---	420	264	166
Gas:			
Manufactured ---million cubic feet--	[r] 35,385	24,706	35,173
Natural ---do---	[r] 2,246	1,816	1,211
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels--	36,278	39,177	33,448
Jet fuel ---do---	6,840	8,320	8,544
Kerosine ---do---	318	217	302
Distillate fuel oil ---do---	73,347	68,528	67,677
Residual fuel oil ---do---	71,429	67,393	68,558
Lubricants ---do---	707	595	707
Other ---do---	23,400	21,682	25,634
Refinery fuel and losses ---do---	8,703	8,356	8,195
Total ---do---	221,022	214,268	213,065

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed individually, Belgium produces a number of other metals for which only aggregate output figures are available. These aggregates are listed under other nonferrous metals.

[2] Known to include gold and silver and may include platinum-group metals.

[3] Derived by subtracting aluminum data from a reported total for unspecified base metals.

[4] Slate only.

TRADE

A slight deficit in the overall balance of payments, technically the first since 1968, marked the year; the balance of trade continued to be unfavorable with another deficit over $2 billion.[2] While the annual fluctuations were not greatly significant, a longer term weakening of the trade balance was feared as a result of two changes in the minerals position of Belgium: (1) Higher prices for oil imports, and (2) expectations of continued reduced demand and reduced prices for Belgian (and Luxembourg) steel on international markets.

Belgium was an importer and processor of mineral raw materials, and an exporter of refined and fabricated mineral products. About 74% of exports and 67% of imports were to and from the Common Market countries in 1976; 3.5% of exports went to the United States and 6% of imports came from the United States. Mineral imports were valued at about $6 billion, or 23% of all imports; of this, about 60% was fuels, largely petroleum from the Middle East and natural gas from the Netherlands. Base metal ores were imported in large quantities from Zaire, Canada, and Peru. Iron ore was imported mainly from Sweden and France.

[2] Where necessary, values have been converted from Belgian francs (BF) to U.S. dollars at the rate of BF38.60=US$1.00.

Table 2.—Belgium-Luxembourg: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite and concentrate	175	75	NA.
Oxide and hydroxide	306	437	West Germany 388.
Ash and residue containing aluminum	2,524	4,870	France 3,727; West Germany 1,058.
Metal including alloys:			
Scrap	20,177	18,096	France 6,983; West Germany 6,019.
Unwrought	20,297	9,972	West Germany 4,137; Netherlands 3,464; France 1,504.
Semimanufactures	195,971	169,848	France 29,796; West Germany 28,314; Netherlands 21,581; United States 21,356.
Antimony:			
Ore and concentrate	188	31	NA.
Metal including alloys, all forms	160	44	Poland 20; Austria 11.
Arsenic, natural sulfides	95	249	NA.
Beryllium metal including alloys, all forms kilograms	600	200	NA.
Bismuth metal including alloys, all forms	832	NA	
Cadmium metal including alloys, all forms	871	917	United States 488; France 258; West Germany 117.
Chromium:			
Chromite	475	208	NA.
Oxide, hydroxide, trioxide	70	33	NA.
Metal including alloys, all forms	123	127	NA.
Copper:			
Ore and concentrate	1,004	4,399	Bulgaria 3,900.
Matte	5,886	1,204	Spain 1,000.
Copper sulfate	9,348	7,631	Netherlands 2,257; Denmark 1,593; West Germany 1,394.
Ash and residue containing copper	6,384	7,104	West Germany 1,374; France 1,101.
Metal including alloys:			
Scrap	16,116	7,855	France 2,479; West Germany 1,656; Netherlands 1,417; Italy 856.
Unwrought	294,344	254,688	France 93,991; West Germany 41,173; United Kingdom 34,008.
Semimanufactures	151,260	146,004	West Germany 41,740; France 41,040; Netherlands 29,045.
Germanium metal including alloys, all forms	26	(1)	NA.
Gold:			
Waste and sweepings—value, thousands	$75	$535	West Germany $340; Netherlands $195.
Metal, unworked or partly worked thousand troy ounces	757	475	West Germany 129; United Kingdom 123; Netherlands 108; Switzerland 84.

See footnotes at end of table.

Table 2.—Belgium-Luxembourg: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Iron and steel:			
Ore and concentrate, except roasted pyrite ---thousand tons--	69	71	France 67.
Roasted pyrite ---do---	174	155	West Germany 154.
Metal:			
Scrap ---do---	727	531	West Germany 232; France 143.
Pig iron including cast iron --do---	11	11	West Germany 6; France 3; Argentina 1.
Sponge iron, powder, shot ---do---	3,401	1	All to West Germany.
Spiegeleisen ---	514	859	West Germany 614; France 115.
Ferroalloys:			
Ferromanganese -thousand tons--	58	43	West Germany 11; France 10; Italy 8; Romania 5.
Other ---do---	18	15	West Germany 3; France 1.
Steel, primary forms ---do---	2,543	2,400	France 720; West Germany 349.
Semimanufactures:			
Bars, rods, angles, shapes, sections ---do---	6,503	4,526	West Germany 1,101; France 748; Netherlands 504.
Universals, plates, sheets -do---	5,660	3,691	France 1,038; West Germany 946.
Hoop and strip ---do---	849	594	West Germany 239; France 131.
Rails and accessories ---do---	115	95	France 24; West Germany 15.
Wire ---do---	350	342	West Germany 73; Netherlands 52; France 48; United States 41.
Tubes, pipes, fittings ---do---	338	240	West Germany 47; U.S.S.R. 44; Netherlands 33.
Castings and forgings, rough do---	42	39	West Germany 8; Netherlands 6; France 5.
Lead:			
Ore and concentrate ---	4,866	2	NA.
Oxides ---	6,605	4,919	West Germany 1,997; Netherlands 1,748; France 499.
Ash and residue containing lead ---	8,537	8,322	Netherlands 6,632.
Metal including alloys:			
Scrap ---	11,253	6,642	France 3,289; Netherlands 1,937.
Unwrought ---	52,869	60,490	Netherlands 25,765; France 15,457; West Germany 6,654.
Semimanufactures ---	4,407	4,368	Netherlands 2,295; France 520.
Magnesium metal including alloys:			
Scrap ---	542	NA	
Unwrought ---	307	323	United States 72; Netherlands 43.
Manganese:			
Ore and concentrate ---	6,797	8,786	Netherlands 2,695; France 2,590; Italy 1,118.
Metal ---	169	73	West Germany 46.
Mercury ---76-pound flasks--	5,338	1,682	West Germany 1,421.
Molybdenum:			
Ore and concentrate ---	3,317	3,964	West Germany 1,084; Italy 964; Sweden 608; Japan 506.
Metal including alloys, all forms ---	35	123	Austria 72.
Nickel:			
Matte, speiss, similar materials ---	45	10	All to France.
Metal including alloys:			
Scrap ---	2,002	1,037	West Germany 607; France 255.
Unwrought ---	315	443	West Germany 217; France 187.
Semimanufactures ---	2,672	2,091	France 16; United Kingdom 7.
Platinum-group metals including alloys, all forms ---thousand troy ounces--	82	843	West Germany 66.
Selenium, elemental ---kilograms--	75,000	39,800	Netherlands 14,400; United States 9,000; West Germany 8,700.
Silver metal including alloys thousand troy ounces--	28,398	25,367	United Kingdom 10,417; West Germany 5,948; Italy 2,733.
Tin:			
Ore and concentrate ---	749	632	Spain 430; United States 110.
Oxides ---	180	97	Finland 50; France 47.
Metal including alloys:			
Scrap ---	227	110	Netherlands 56; France 39.
Unwrought ---	1,799	1,907	France 570; West Germany 340; Turkey 216; Czechoslovakia 205.
Semimanufactures ---	512	118	France 46; Netherlands 23.

See footnotes at end of table.

Table 2.—Belgium-Luxembourg: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Titanium:			
Ore and concentrate	48	5	NA.
Oxides	30,632	21,232	West Germany 9,282; France 3,884.
Metal including alloys, all forms	86	11	Netherlands 8.
Tungsten:			
Ore and concentrate	160	84	United Kingdom 51; Spain 21; West Germany 12.
Metal including alloys, all forms	136	123	Netherlands 92.
Uranium and titanium ore and concentrate	54	234	All to France.
Vanadium oxides—kilograms	10,300	141,800	Czechoslovakia 67,800; West Germany 31,500.
Zinc:			
Ore and concentrate	68,950	22,669	France 20,517.
Oxides	6,338	5,117	West Germany 1,574; Netherlands 1,076; France 858.
Ash and residue containing zinc	40,853	39,845	Netherlands 29,756; France 6,862.
Metal including alloys:			
Scrap	8,972	4,734	France 3,913.
Blue powder (dust)	31,506	20,894	West Germany 7,333; Netherlands 6,790; France 2,124.
Unwrought	193,632	180,211	West Germany 47,930; France 31,014; United States 23,440.
Semimanufactures	7,879	5,449	West Germany 2,135; Netherlands 1,559.
Other:			
Ore and concentrate:			
Of niobium, tantalum, vanadium, zirconium	216	242	West Germany 162.
Of precious metals	1	1	NA.
Of base metals, n.e.s	627	265	NA.
Ash and residue containing nonferrous metals, n.e.s	26,876	34,800	West Germany 4,624; United States 1,096.
Waste and sweepings of precious metals value, thousands	$2,366	$3,713	United Kingdom $1,989; France $754; West Germany $606.
Oxides, hydroxides and pentoxides of metals, n.e.s	5,973	1,025	France 337; West Germany 266; United States 123.
Metals including alloys, all forms:			
Metalloids:			
Tellurium and arsenic	33	10	Italy 3; France 2.
Other	163	134	West Germany 19.
Alkali, alkaline earth, rare-earth metals	56	101	NA.
Pyrophoric alloys—kilograms	26	300	NA.
Base metals including alloys, all forms, n.e.s	15,997	172	Austria 104.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	6,553	27,228	West Germany 26,770.
Dust and powder of precious and semi-precious stones, natural and manufactured—kilograms	621	747	Netherlands 184; Poland 181; Israel 108.
Grinding and polishing wheels and stones	3,922	3,342	France 1,733.
Asbestos	645	1,821	Netherlands 1,106; France 296.
Barite and witherite	416	434	Spain 22.
Boron materials:			
Crude natural borates	9,634	4,159	Netherlands 2,849; France 760; Sweden 500.
Oxide and acid	306	171	India 90.
Bromine—kilograms	460	24,400	NA.
Cement—thousand tons	1,593	1,232	Netherlands 798; Nigeria 119.
Chalk	67,250	53,152	Netherlands 21,931; France 8,623.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Bentonite	929	3,551	France 2,469; West Germany 602.
Kaolin	8,778	3,655	Netherlands 1,817; West Germany 757.
Other	3,689	37,426	Netherlands 32,318.

See footnotes at end of table.

Table 2.—Belgium-Luxembourg: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Clays and clay products (including all refractory brick)—Continued			
Products:			
Refractory (including nonclay bricks)	49,379	41,064	France 19,839; West Germany 7,994; Italy 3,903.
Nonrefractory ----value, thousands--	$22,960	$14,804	Netherlands $6,077; France $2,834; West Germany $2,351.
Cryolite and chiolite	164	987	NA.
Diamond:			
Gem:			
Unworked ----------thousand carats--	5.479	8,459	United Kingdom 3,216; India 2,771; Israel 1,067.
Worked ----------do----	2,777	2,256	United States 640; United Kingdom 301; West Germany 266.
Industrial:			
Unworked ----------do----	9,104	5,871	United Kingdom 1,525; United States 1,224; West Germany 593.
Worked ----------do----	27	27	Bermuda 16; United Kingdom 5.
Diatomite and other infusorial earth	5,491	8,162	Netherlands 7,311.
Feldspar, leucite, nepheline, nepheline syenite	11,902	8,867	Netherlands 8,641.
Fertilizer materials:			
Crude:			
Nitrogenous	1,323	1,141	France 537; Lebanon 250; West Germany 198.
Phosphatic	39,805	27,996	France 17,114; West Germany 7,719.
Potassic, K_2O content	207	9,030	NA.
Manufactured:			
Nitrogenous, N_2 content thousand tons--	389	288	France 81; West Germany 76.
Phosphatic P_2O_5 content ------do----	359	309	West Germany 111; France 103.
Potassic, K_2O content --------do----	287	223	France 42; Norway 41.
Other including mixed --------do----	15	13	France 8; Denmark 1; India 1.
Ammonia ----------do----	160	190	France 109; United States 25.
Fluorspar	1,321	343	NA.
Graphite, natural	7	250	West Germany 112; France 109.
Gypsum and plaster	35,141	47,389	Netherlands 26,409.
Lime ----------thousand tons--	709	691	Netherlands 562.
Magnesite	2,034	1,859	France 1,232.
Mica:			
Crude including splittings and waste	70	108	NA.
Worked including agglomerated splittings	1,360	1,419	United States 489; United Kingdom 212; West Germany 170.
Pigments, mineral, including processed iron oxides	4,369	4,669	France 1,183; Italy 876.
Precious and semiprecious stones:			
Natural (except diamond):			
Unworked ----------kilograms--	6,026	665	Switzerland 420; India 199.
Worked:			
Gem ----------do----	1,754	2,020	West Germany 183.
Industrial ----------do----	(1)	(1)	NA.
Manufactured [2]	155	201	West Germany 41.
Pyrite (gross weight)	548	312	NA.
Salt and brine	123,690	103,992	France 90,784.
Sodium and potassium compounds thousand tons--	447	214	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous ------thousand tons--	1,059	871	Netherlands 820.
Slate ----------do----	3	4	Netherlands 2; West Germany 1.
Other ----------do----	59	37	Netherlands 3.
Worked:			
Slate ----------do----	1	1	Mainly to France and West Germany.
Paving and flagstone -----do----	9	13	Netherlands 11; West Germany 2.
Other ----------do----	11	9	France 2; Netherlands 2; West Germany 2.
Dolomite, chiefly refractory grade -do----	1,835	1,618	Netherlands 710; West Germany 633.
Gravel and crushed rock ----------do----	8,988	9,495	Netherlands 4,797; France 3,906.
Limestone (except dimension) ----do----	600	665	Netherlands 420; France 232.

See footnotes at end of table.

Table 2.—Belgium-Luxembourg: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Stone, sand and gravel—Continued			
Quartz and quartzite ----thousand tons--	15	15	West Germany 12.
Sand excluding metal bearing ----do----	3,989	3,161	France 857; Netherlands 663; Italy 373; West Germany 331.
Sulfur:			
Elemental, all forms ----------	18,759	17,473	France 8,863; West Germany 3,210.
Sulfur dioxide ----------	203	21	NA.
Sulfuric acid ----------	286,903	106,320	France 71,601; Turkey 12,463.
Talc, steatite, soapstone, pyrophyllite --------	21,813	15,656	West Germany 4,248; United Kingdom 2,562; Sweden 2,219; France 1,791.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet ----------	231	336	NA.
Lithium minerals ----------	6,263	3,685	Netherlands 3,641.
Vermiculite, perlite, chlorite --------	233	117	NA.
Other ----------thousand tons--	761	328	Netherlands 302.
Slag, dross, and similar waste, not metal bearing ----------do----	2,847	2,903	Netherlands 1,237; France 858; West Germany 720.
Oxides and hydroxides of magnesium, strontium, barium ----------	666	1,805	NA.
Halogens ----------	19	NA	
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural ----------	9,204	5,860	NA.
Carbon black and gas carbon:			
Carbon black ----------	20,165	11,841	West Germany 10,750.
Gas carbon ----------	150	31	NA.
Coal and briquets:			
Anthracite and bituminous coal thousand tons--	527	542	West Germany 275; France 208.
Briquets of anthracite and bituminous coal ----------do----	61	20	France 13.
Lignite and lignite briquets ----------	32	3	NA.
Coke and semicoke ----------thousand tons--	409	360	France 112; Netherlands 72; West Germany 56.
Gas, natural ----------million cubic feet--	26,177	42,416	Netherlands 42,395.
Hydrogen, argon, other rare gases ----------	15,550	13,258	France 6,671; West Germany 2,889; Netherlands 1,509.
Peat including briquets and litter ----------	4,883	859	NA.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels--	411	571	Norway 413.
Refinery products: [3]			
Gasoline ----------do----	5,324	25,336	United Kingdom 6,105; West Germany 4,664; Netherlands 3,978; Sweden 2,973.
Kerosine ----------do----	2,213	5,715	Denmark 1,160; United Kingdom 881; West Germany 853.
Distillate fuel oil ----------do----	21,348	20,711	West Germany 8,511; bunkers 3,151; Sweden 2,746; Denmark 2,352.
Residual fuel oil ----------do----	31,961	31,377	Bunkers 13,216; United Kingdom 3,098; Denmark 3,069.
Lubricants ----------do----	2,633	2,039	Netherlands 648; West Germany 201.
Other:			
Liquefied petroleum gas --do----	1,653	1,707	United States 590; Portugal 243.
White spirit ----------do----	1,371	1,269	Netherlands 614; West Germany 332.
Mineral jelly and wax ----do----	20	13	Netherlands 2; Spain 1; West Germany 1.
Nonlubricating oils, n.e.s -do----	32	7,079	Netherlands 3,331; West Germany 1,660; bunkers 1,030.
Bitumen and other residues do----	2,894	1,800	Netherlands 930; West Germany 302; Norway 223.
Bituminous mixtures, n.e.s-do----	66	75	Netherlands 42; France 20.
Pitch, pitch coke, petroleum coke ----------do----	283	31	Netherlands 31.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals thousand tons--	230	211	Netherlands 70; United States 48; France 38.

NA Not available.
[1] Less than ½ unit.
[2] May include diamond.
[3] Includes bunkers.

Table 3.—Belgium-Luxembourg: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	23,814	16,380	Guyana 6,814; West Germany 4,251; Denmark 2,638.
Oxide and hydroxide	17,442	12,689	West Germany 9,918.
Ash and residue containing aluminum	1,219	758	NA.
Metal including alloys:			
Scrap	18,138	14,778	Netherlands 6,088; France 2,938; United States 1,647.
Unwrought	253,205	188,176	Netherlands 68,568; Norway 28,926; France 25,446; West Germany 23,670.
Semimanufactures	70,110	52,140	West Germany 25,070; Netherlands 12,388; France 7,541.
Antimony:			
Ore and concentrate	9,221	8,707	Bolivia 5,953; Canada 1,288.
Metal including alloys, all forms	72	222	Netherlands 80; France 65; West Germany 47.
Arsenic:			
Natural sulfides	24	53	NA.
Trioxides, pentoxides, acids	311	121	United States 9.
Beryllium metal including alloys, all forms kilograms	200	300	NA.
Bismuth metal including alloys, all forms	717	NA	
Cadmium metal including alloys, all forms	1,477	978	Japan 362; U.S.S.R. 106.
Chromium:			
Chromite	4,051	3,714	Netherlands 2,266; Mozambique 559.
Oxide and hydroxide	693	555	West Germany 316; U.S.S.R. 150.
Metal including alloys, all forms	200	232	United Kingdom 147; West Germany 36.
Cobalt oxides and hydroxides ----kilograms	11,900	20,600	West Germany 19,200.
Copper:			
Ore and concentrate	32,406	46,651	Zaire 7,867; Peru 5,439; Chile 5,200; Morocco 4,681.
Matte	201,189	214,471	Zaire 139,887; Republic of South Africa 25,525.
Copper sulfate	652	1,084	U.S.S.R. 585; France 342.
Ash and residue containing copper	54,878	38,970	France 13,168; United States 8,874; Chile 6,485.
Metal including alloys:			
Scrap	NA	58,545	France 21,531; United States 11,547; Netherlands 9,182.
Unwrought	292,323	190,656	Zaire 94,707.
Semimanufactures	25,466	25,768	West Germany 13,333; France 5,081; Netherlands 3,039.
Germanium metal including alloys, all forms	17	NA	
Gold:			
Waste and sweepings --value, thousands	$1,446	$610	United States $372; Netherlands $188.
Metal, unworked and partly worked thousand troy ounces	3,499	2,623	Switzerland 1,587; United States 173.
Iron and steel:			
Ore and concentrate, except roasted pyrite ----thousand tons	33,430	25,520	France 10,802; Sweden 4,919.
Roasted pyrite ----do----	497	214	West Germany 121; France 73.
Metal:			
Scrap ----do----	870	706	France 284; Netherlands 175; West Germany 79.
Pig iron including cast iron --do----	233	161	France 67; West Germany 65.
Sponge iron, powder, shot ----do----	9	6	France 3; West Germany 1; Sweden 1.
Spiegeleisen ----do----	(1)	(1)	NA.
Ferroalloys ----do----	215	153	France 52; Norway 39.
Steel, primary forms ----do----	970	810	West Germany 275; Netherlands 240; France 148.
Semimanufactures:			
Bars, rods, angles, shapes, sections ----do----	724	734	France 266; West Germany 180; Netherlands 91.
Universals, plates, sheets --do----	654	520	Netherlands 142; Japan 132; West Germany 104.
Hoop and strip ----do----	116	100	France 50; West Germany 20.
Rails and accessories ----do----	33	11	France 6; West Germany 3.
Wire ----do----	60	40	West Germany 22; Netherlands 6; France 5.
Tubes, pipes, fittings ----do----	182	192	Netherlands 52; France 44; West Germany 44.

See footnotes at end of table.

Table 3.—Belgium-Luxembourg: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures—Continued			
Castings and forgings, rough thousand tons	16	22	France 8; West Germany 6; Netherlands 3.
Lead:			
Ore and concentrate	88,030	90,268	Bolivia 15,322; Canada 12,079; Australia 10,481.
Ash and residue containing lead	45,663	63,015	United States 13,908; France 13,550; United Kingdom 8,728.
Oxides	2,246	843	West Germany 496; France 288.
Metal including alloys:			
Scrap	11,497	12,439	Netherlands 4,154; West Germany 4,138; United States 1,557.
Unwrought	24,786	13,857	France 5,363; United Kingdom 3,503; West Germany 2,152; Netherlands 1,882.
Semimanufactures	2,943	2,074	West Germany 916; Netherlands 768.
Magnesium metal including alloys:			
Scrap	270	153	West Germany 25.
Unwrought	1,465	1,207	Italy 317; Norway 262; France 234; Netherlands 216.
Semimanufactures	150	183	France 57; West Germany 48; United States 31.
Manganese:			
Ore and concentrate	400,246	313,264	Republic of South Africa 153,238; Zaire 72,077.
Oxides	2,220	1,275	Japan 534; France 527.
Metal	1,226	615	Republic of South Africa 226; Japan 189.
Mercury 76-pound flasks	5,773	8,963	Italy 5,192; Spain 1,102; Yugoslavia 1,102.
Molybdenum:			
Ore and concentrate	12,545	13,175	Canada 5,289; United States 3,436; Chile 1,852; United Kingdom 1,556.
Metal including alloys, all forms	70	77	Netherlands 45; United States 11.
Nickel:			
Matte, speiss, similar materials	271	87	United Kingdom 31; Netherlands 21; Republic of South Africa 16; Canada 13.
Metal including alloys:			
Scrap	1,423	1,060	United States 206; France 178; Singapore 157; Netherlands 109.
Unwrought	3,988	3,495	United Kingdom 788; Cuba 490; Canada 460; Republic of South Africa 379.
Semimanufactures	3,427	3,316	West Germany 1,527; France 1,224; United Kingdom 389.
Platinum-group metals including alloys, all forms troy ounces	108,881	292,539	United States 206,472; United Kingdom 32,472.
Selenium, elemental kilograms	19,100	42,300	NA.
Silver metal including alloys thousand troy ounces	23,517	18,711	Netherlands 5,208; United States 3,987.
Thorium ore and concentrate kilograms	NA	NA	
Tin:			
Ore and concentrate	5,281	7,210	Zaire 4,804; Rwanda 1,669.
Oxides	30	40	West Germany 22; Netherlands 16.
Metal including alloys:			
Scrap	83	113	France 53; West Germany 43; Netherlands 15.
Unwrought	2,914	1,756	Zaire 671; Malaysia 506.
Semimanufactures	256	300	Netherlands 120; West Germany 99.
Titanium:			
Ore and concentrate	120,527	31,350	Canada 30,757.
Oxides	11,618	10,522	West Germany 4,675; Netherlands 3,155; France 1,433.
Metal including alloys, all forms	1,739	1,598	United States 1,379.

See footnotes at end of table.

Table 3.—Belgium-Luxembourg: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Tungsten:			
Ore and concentrate	458	375	Zaire 120; Australia 97.
Metal including alloys, all forms	266	157	Netherlands 117.
Uranium:			
Ore and concentrate ——kilograms	52,200	NA	
Metal including alloys, all forms thousand tons	6,336	NA	
Zinc:			
Ore and concentrate	644,850	610,984	Canada 391,809.
Oxide and peroxide	9,273	7,548	France 2,891; Netherlands 1,615; United Kingdom 1,188.
Ash and residue containing zinc	90,404	71,610	Peru 29,937; West Germany 16,807.
Metal including alloys:			
Scrap	12,066	14,330	United States 7,663; Netherlands 1,579; France 1,551.
Blue powder	1,681	784	West Germany 356; Netherlands 170.
Unwrought	69,592	23,885	United States 7,225; Zaire 3,000; Australia 2,701; Canada 2,614.
Semimanufactures	10,903	9,167	France 8,132.
Other:			
Ore and concentrate:			
Of niobium, tantalum, vanadium, zirconium	2,282	1,002	United Kingdom 310; Republic of South Africa 175; West Germany 174.
Of precious metals	252	241	Colombia 224.
Of base metals, n.e.s	8,075	475	Italy 27; Bolivia 20.
Ash and residue containing nonferrous metals, n.e.s	45,059	33,993	Republic of South Africa 4,242.
Waste and sweepings of precious metals value, thousands	$41,859	$17,209	United States $10,676; Netherlands $2,164; France $2,151.
Oxides, hydroxides and peroxides of metals, n.e.s	3,247	1,936	West Germany 1,077; Republic of South Africa 201.
Metals including alloys, all forms:			
Metalloids:			
Tellurium and arsenic	66	69	Sweden 50.
Other	851	440	West Germany 177; France 137.
Alkali, alkaline-earth and rare-earth metals	112	49	Netherlands 3; West Germany 3.
Pyrophoric alloys	6	3	NA.
Base metals including alloys, all forms, n.e.s	18,245	75	United States 44; France 10.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	144,841	90,247	West Germany 89,781.
Dust and powder of precious and semi-precious stones, natural and manufactured, including diamond kilograms	27,246	1,974	Ireland 906; United States 600.
Grinding and polishing wheels and stones	2,874	2,533	West Germany 724; France 457; Austria 416.
Asbestos	82,662	60,549	Canada 27,456; U.S.S.R. 14,357; Republic of South Africa 10,615.
Barite and witherite	7,210	7,829	France 6,020.
Boron materials:			
Crude natural borates	71,557	49,838	Netherlands 35,301; West Germany 5,715.
Oxide and acid	2,241	1,495	France 1,075; West Germany 200.
Bromine ——kilograms	79,100	46,100	NA.
Cement	150,318	76,328	Netherlands 41,150; France 12,700.
Chalk	114,577	116,468	France 88,569.
Clays and clay products:			
Crude clays, n.e.s.:			
Bentonite	17,296	22,654	West Germany 9,815; Netherlands 6,264.
Kaolin	301,766	237,206	United Kingdom 86,359; West Germany 73,563; Netherlands 49,566.
Other	273,867	198,853	West Germany 107,871; France 37,170; Netherlands 22,430.

See footnotes at end of table.

Table 3.—Belgium-Luxembourg: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Clays and clay products—Continued			
Products:			
Refractory (including nonclay bricks)	169,604	108,054	West Germany 54,021; Austria 16,214.
Nonrefractory ----value, thousands--	$80,326	$75,742	West Germany $22,128; Italy $18,532; Netherlands $16,691.
Cryolite and chiolite	339	112	NA.
Diamond (except powder):			
Gem:			
Unworked ----------thousand carats--	10,425	12,535	United Kingdom 9,969.
Worked ----------do----	1,276	1,279	U.S.S.R. 296; India 204; Israel 185.
Industrial:			
Unworked ----------do----	8,545	7,772	Ireland 2,390; United States 1,721; United Kingdom 1,295.
Worked ----------do----	28	7	Switzerland 2; United Kingdom 2.
Diatomite and other infusorial earth	8,402	7,402	France 3,288; Denmark 1,676; United States 1,292.
Feldspar, leucite, nepheline, nepheline syenite	78,559	61,532	Norway 39,999; France 16,369.
Fertilizer materials:			
Crude:			
Nitrogenous	19,199	12,464	Chile 11,529.
Phosphatic ----------thousand tons--	2,407	1,771	Morocco 1,231.
Potassic	(2)	1,286,227	France 669,740; West Germany 616,341.
Manufactured:			
Nitrogenous, N_2 content	72,490	10,213,191	West Germany 3,564,495; France 2,369,386; Netherlands 1,706,906.
Phosphatic, P_2O_5 content	16,534	1,320,278	United States 289,176; Netherlands 273,204; Algeria 227,860.
Potassic	(2)	53,255,196	West Germany 20,384,133; France 18,399,050; U.S.S.R. 7,872,008.
Other including mixed	163,954	122,643	France 47,995; West Germany 33,125; Netherlands 19,691.
Ammonia	2,244	1,499	West Germany 800; Netherlands 540.
Fluorspar	15,433	10,101	France 4,072; West Germany 2,534; East Germany 1,915.
Graphite, natural	1,454	1,915	Malagasy Republic 1,011; West Germany 295; France 195.
Gypsum and plaster	537,189	470,371	France 445,228.
Lime	210,102	107,573	France 94,877.
Magnesite	29,716	25,940	Greece 13,130.
Mica:			
Crude including splittings and waste	3,171	7,034	India 4,673; Malagasy Republic 1,486.
Worked including agglomerated splittings	94	38	Switzerland 9; France 5; West Germany 4; United Kingdom 3.
Pigments, mineral, including processed iron oxides	11,237	6,104	West Germany 4,810.
Precious and semiprecious stones, except diamond:			
Natural:			
Unworked ----------kilograms--	5,550	9,543	Brazil 5,512; West Germany 2,827.
Worked:			
Gem ----------do----	3,262	1,449	West Germany 854; India 107.
Industrial ----------do----	256	42	NA.
Manufactured ----------do----	25,794	3,816	United States 3,597.
Pyrite (gross weight)	257,916	207,810	Spain 134,223; Portugal 67,387.
Salt and brine ----------thousand tons--	1,144	796	Netherlands 404; West Germany 346.
Sodium and potassium, n.e.s	40,244	44,605	West Germany 21,847; Netherlands 14,843.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	143,128	155,295	France 68,709; Portugal 19,560; West Germany 15,504.
Worked	59,257	67,655	Italy 21,628; France 14,292; Portugal 7,339.
Dolomite, chiefly refractory grade	68,724	74,991	West Germany 33,969; France 30,448; Netherlands 10,114.
Gravel and crushed rock ----thousand tons--	5,936	5,249	Netherlands 2,774; West Germany 801; France 756.
Limestone (except dimension)	208,571	281,893	United Kingdom 174,872.
Quartz and quartzite	112,231	115,822	West Germany 79,937; France 16,924.

See footnotes at end of table.

Table 3.—Belgium-Luxembourg: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Stone, sand and gravel—Continued			
Sand excluding metal bearing thousand tons	8,544	8,959	Netherlands 7,764.
Sulfur:			
Elemental, all forms	938,533	441,676	United States 323,698.
Sulfur dioxide	4,246	4,182	West Germany 3,973.
Sulfuric acid	238,079	162,263	West Germany 103,946; Netherlands 24,334.
Talc, steatite, soapstone, pyrophyllite	39,958	23,403	United States 5,423; France 4,027; Netherlands 3,959; Australia 3,555.
Other nonmetals, n.e.s.:			
Crude:			
Lithium minerals	7,525	4,586	Republic of South Africa 3,399; Mozambique 757.
Vermiculite, perlite, chlorite	26,841	55,903	U.S.S.R. 36,283; Turkey 12,817.
Other	125,933	166,368	Netherlands 70,511; Spain 55,252; West Germany 27,693.
Slag, dross and similar waste, not metal bearing	346,880	468,751	France 364,277; Netherlands 46,860.
Oxides and hydroxides of magnesium, strontium and barium	2,068	1,023	West Germany 271.
Halogens (other than chlorine and bromine)	207	NA	
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	40,602	66,155	France 54,178; Netherlands 10,340.
Carbon black and gas carbon:			
Carbon black	32,920	25,478	Netherlands 9,178; West Germany 9,132; France 2,831.
Gas carbon	2,711	2,311	West Germany 2,062.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	9,977	6,793	West Germany 3,776; Poland 1,145.
Briquets of anthracite and bituminous coal do.	89	162	West Germany 120.
Lignite and lignite briquets do.	85	62	West Germany 60.
Coke and semicoke do.	4,545	3,022	West Germany 2,471.
Gas, natural million cubic feet	1,023,186	629,044	Netherlands 397,407.
Hydrogen, argon, rare gases	7,635	5,112	Netherlands 2,951; West Germany 1,337.
Peat including peat briquets and litter	101,292	115,535	Netherlands 57,342; West Germany 56,938.
Petroleum:			
Crude and partly refined:			
Crude thousand 42-gallon barrels	205,113	183,176	Saudi Arabia 85,232; Iran 33,054.
Partly refined do.	7,274	23,320	Kuwait 4,928; Iran 4,711; U.S.S.R. 3,542.
Refinery products:			
Gasoline do.	25,536	6,006	Netherlands 4,453.
Kerosine do.	55	563	Italy 224; United Kingdom 162; Netherlands 151.
Distillate fuel oil do.	18,148	23,492	Netherlands 14,031; U.S.S.R. 3,265.
Residual fuel oil do.	31,297	14,272	Netherlands 10,663.
Lubricating oil and grease do.	3,623	2,877	Netherlands 1,001; France 532; Italy 371.
Other:			
Liquefied petroleum gas do.	4,446	4,895	Netherlands 3,932.
White spirit do.	3,419	110	Netherlands 47; United States 30; France 28.
Mineral jelly and wax do.	157	94	West Germany 55; France 24.
Nonlubricating oil, n.e.s do.	64	1,984	Netherlands 1,585; West Germany 336.
Bitumen and other residues do.	526	909	France 564; Netherlands 273.
Bituminous mixtures, n.e.s do.	418	145	Netherlands 73; France 48.
Pitch, pitch coke, petroleum coke do.	2,811	787	United States 649.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	120,820	112,799	Netherlands 54,025; West Germany 32,737; France 11,494.

NA Not available.

[1] Less than ½ unit.

[2] Crude and manufactured potassic fertilizers not reported separately and total of these commodities not reported in terms of gross weight but rather in terms of K_2O equivalent. Total for 1974 was 654,076 tons. Principal sources in 1974 were: West Germany 260,364; France 184,679; U.S.S.R. 137,624.

COMMODITY REVIEW

Metals.—*Copper.*—Recent expansion of the Olen electrolytic refinery to a nominal capacity of 330,000 tons per year took effect in 1976. Total domestic production of refined copper including secondary metal and alloys reached about 480,000 tons, an increase of more than 100,000 tons compared with that of 1975.

Métallurgie Hoboken-Overpelt S.A. continued its 5-year investment program despite unfavorable market conditions and rising labor costs. The company's second new wire-rod (Contirod) plant began production at Olen, raising total company capacity from 100,000 tons to 250,000 tons per year of continuous 5/16-inch rods for production of wire.

Hoboken-Overpelt controlled about half of Belgium's copper-smelting capacity of 90,000 tons in 1976, and almost 90% of refining capacity of 395,000 tons of primary copper. The remainder of Belgium's smelting and refining capacities was controlled by Métallo-Chimique S.A.

Iron and Steel.[3]—Sizable losses, growing lack of competitiveness, and continued inactivity in steel markets led to structural changes in the Belgian steel industry. In July, several corporations in the Charleroi area consolidated many functions, while remaining independent in name and management. Sté. Métallurgique Hainaut-Sambre S.A. (HS), S.A. Forges de Thy-Marcinelle et Monceau (TMM), and Laminoirs du Ruau (LR) came under the control of a newly established holding company, Financière de Ruau, which was jointly controlled by the Frère-Bourgeois group, Banque Bruxelles-Lambert, and Banque de Paris et des Pays Bas. Albert Frère was appointed chief executive of all three manufacturing firms. Production of the three firms was around 4.8 million tons in 1976, consisting chiefly of rolled basic products to be used in the construction industry or other metalworking.

This reorganization followed the formation of the Cockerill group (S.A. Cockerill-Ougrée-Providence et Espérance-Longdoz) in the early 1970's by a number of steelmakers in the Liège area. Cockerill's peak production, primarily sheets, was 6.6 million tons in 1974; since that time, production has declined owing to reduced demand. The third center of Belgian steel production was at Zelzate, the port for Ghent, where Sidérurgie Maritime S.A. (SIDMAR), a subsidiary of Aciéries Réunies de Burbach-Eich-Dudelange S.A. (ARBED) of Luxembourg, reached a peak production of 2.25 million tons of large, wide, flat products in 1974.

In December, Cockerill, HS, TMM, and LR agreed formally to coordinate and collaborate on measures to restore their competitiveness while retaining their present legal structures. These firms, controlling about 60% of the industry, agreed to exchange information, jointly conduct studies, and coordinate policies and planning. The agreement was open to other firms, notably the two large producers outside the Charleroi area, Usines Gustave Boël at La Louvière and Forges de Clabecq at Clabecq, each of which produced a million or more tons per year of steel.

The steel industry in Wallonia, the French-speaking half of Belgium, that included Liège and Charleroi, employed over 50,000 persons in 1976, and thus could not be allowed to collapse. Its problems, however, were severe, including an unbalanced product mix; a small domestic market (80% of production was exported in 1975); an inconvenient location, resulting from former dependence on the coal mines of the Campine and the nearby iron ore deposits of Lorraine (France), both now approaching exhaustion; high labor costs, with wages and benefits being the highest in the world as a result of Government policy and recent prosperity of the steel industry; and growing labor unrest. These problems, if not solved by cooperation within Belgium and with other European producers, would require Government intervention to protect jobs and the economy.

Lead and Zinc.—Despite low zinc demand and continued low prices, which forced Société des Mines et Fonderies de Zinc de la Vieille-Montagne S.A. to operate well below capacity, the company continued with its $90 million investment plan. About $25 million was allocated in 1976, mostly to equip the company's mine in Sweden and plants at Viviez and Calais in France. However, at Balen, Belgium, a flotation plant was added to treat electrolytic residues.

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[3] This section is largely based upon reports from the U.S. Embassy, Brussels, Belgium, especially State Department telegram 641, Jan. 21, 1977.

Vieille-Montagne, with a production capacity at Balen of about 168,000 tons per year, continued to be the largest Belgian zinc producer. Other producers of electrolytic zinc were Hoboken-Overpelt, with a 100,000-ton-per-year capacity at Overpelt, and Société de Prayon at Prayon near Liège, with a 60,000-ton-per-year capacity.

In July, Vieille-Montagne permanently closed its lead smelter at Balen, which was too small to operate economically; annual production had been less than 30,000 tons in recent years. Smelter lead continued to be produced chiefly by Hoboken-Overpelt at Hoboken, near Antwerp.

Nonmetals.—*Cement.*—Cimenteries C.B.R. S.A., possibly the largest Belgian cement producer, completed its new plant at Lixhe, Liège Province, in early 1976, at a total investment cost of about $70 million. The plant, with an annual capacity of 1 million tons of clinker, was supplied from the limestone quarry through a 2.2-kilometer-long tunnel, constructed to protect the environment. The new facility was shared with the company's Dutch affiliate, Eerste Nederlandse Cement Industrie N.V. of Maastricht.

Stone.—*Quarzite.*—The Administration des Mines of Belgium reported[4] that high-silica sandstones or quartzites are produced principally in the area of Villerot and Hautrage, west of Mons. In addition, millstone is mined at St. Denis, Obourg, and Ghlin, all close to Mons; normal methods of cutting, blasting, grinding, and washing are followed.

Mineral Fuels.—Consumption of fuels declined in 1975, the latest year for which complete information is available, as a result of the lower industrial activity caused by the economic recession. Petroleum was imported from the Middle East and natural gas, from the Netherlands. The only significant domestic source of energy was the declining coal mining industry, which was to continue at approximately present levels through Government support. An approximate energy balance is given in table 4.

Coal.—Although coal consumption increased in 1976, Belgian production declined to just over 7 million tons, continuing a long-term trend. Production declined 25% in the southern basins after two shafts were closed. In the Campine Basin, however, where the major remaining Belgian reserves are located production remained unchanged. Imported coal continued to displace Belgian coal, especially in the steel industry; in 1976, imports from the United States increased significantly owing to favorable prices for coking coal.

The Government, determined to keep Belgium's coal mining industry alive, was prepared to provide necessary subsidies to protect employment and the domestic supply of energy. With Government aid, production should not decline in the future below 7 million tons per year. In addition, the Government made plans to investigate underground coal gasification in 1977 at a site near Thulin, near Mons, where con-

[4] U.S. Embassy, Brussels, Belgium. State Department Airgram A-72, Mar. 30, 1977, 7 pp.

Table 4.—Belgium-Luxembourg: Supply and apparent consumption of fuels and power for 1974 and 1975

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Hydroelectric and nuclear power
1974:					
Production	8.4	8.1	--	0.2	0.1
Imports	81.3	10.8	54.8	15.4	.3
Exports	18.9	.9	[2] 16.9	.8	.3
Apparent consumption	[3] 70.8	18.0	[3] 37.9	14.8	.1
1975:					
Production	8.3	7.5	--	--	.8
Imports	72.9	7.0	55.9	9.5	.5
Exports	20.2	.7	[2] 18.4	.5	.6
Apparent consumption	[3] 61.0	13.8	[3] 37.5	9.0	.7

[1] 1 ton of standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Includes bunkers.
[3] Includes refinery and other losses.

Source: Organization for Economic Cooperation and Development. Energy Statistics, 1973–1975. Paris.

tinued conventional mining was uneconomic. The Sartis pit was closed in this area in 1976, and Cockerill closed the Colard pit near Liège at the same time; there were then seven small mines (producing a total of about 1 million tons per year) in the Charleroi-Namur-Liège Basins, and five large mines (producing a total of 6 million tons) in the Campine (Kempen) Basin.

Petroleum.—Esso Belgium completed a modernization and expansion program, raising capacity at its refinery in Antwerp 150,000 barrels per day (7.5 million tons per year) to a reported 240,000 barrels per day (12 million tons per year), an increase of more than 160%. The expansion, carried out in the face of a large surplus of oil refinery capacity, was based on a decision made prior to the petroleum price rise of 1973.

Total Belgian refining capacity was about 1.1 million barrels per day after the Esso expansion. Eight refineries were in operation. Five were in the Antwerp area including Esso (240,000 barrels per day), Anglo-Belge des Pétroles, S.A. (4,900), Albatross S.A. (120,000), Société Industrielle Belge des Pétroles (340,000), and Raffinerie Belge des Pétroles (95,000). One refinery was at Feluy (Chevron Oil Belgium N.V., 140,000) and two were at Ghent (S.A. Texaco Belgium N.V., 180,000, and Shell, 9,000).

A refined products pipeline, with a projected capacity of 8 million tons per year, was to be built by Pipeline Antwerpen Limburg Luik N.V. from Antwerp to DSM's chemical complex at Geleen, the Netherlands. The pipeline was to be owned by the Belgian Government (51%) and DSM.

LUXEMBOURG

The year was dominated by the severe crisis in the steel industry that had begun in 1974. Production of crude steel declined about 1% in Luxembourg compared with that of 1975, although other European steel-producing nations were able to register small gains. Luxembourg production continued almost 30% below the 1974 level. The effect was particularly severe on the Luxembourg economy because the value of steel production represented almost half of the value of the country's industrial production, about 40% of total exports, and 25% of the gross national product (GNP). The two operating companies that comprise Luxembourg's steel industry suffered high financial losses; ARBED, by far the larger, lost almost $40 million, after losing $80 million in 1975.

ARBED produced about 4.0 million tons of steel in 1976, or 87% of the national total of almost 4.6 million tons; the remainder was produced by Minière et Métallurgique de Rodange-Athus, a Belgian-Luxembourg company straddling the border in the southwest. ARBED continued operating during the year at about 60% of capacity. Shutdowns, transfers of personnel to public-works-type projects, and reduction of the number of shifts worked were effected to avoid layoffs. The problems were aggravated by the large increase in personnel costs in recent years owing to lower productivity, wage increases, and higher social costs. It was feared that the disabilities of the steel industry were structural, and that they stemmed from changes in the world steel market, such as increased competition from Japanese and national steel companies in non-European markets. A further cut in steel industry jobs of at least 2,500 by 1980 was also feared.

ARBED used 9.7 million tons of iron ore in 1976, compared with 10.3 million tons in 1975. About 84% of the total in 1976 came from ARBED's Lorraine minette (low-grade Jurassic ironstone) mines, located in France on the Luxembourg border; the remaining 16% came from the Luxembourg minette mines, chiefly Differdange. Almost none of the high-cost, high-grade foreign ores were needed, because of the general production decline.

Luxembourg's slate quarries continued to suffer from high costs and competition from alternate roofing materials. Production of about 6,000 square meters of slab was only half that produced in 1973. The quarries were located in the community of Perle, west central Luxembourg, near the Belgian border.

Table 5.—Luxembourg: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Iron ore and concentrate	2,686	2,315	2,079
Pig iron (including blast furnace ferroalloys)	5,468	3,889	3,759
Steel:			
Crude	6,448	4,625	4,566
Semimanufactures	4,986	3,479	3,598
NONMETALS			
Cement, hydraulic	391	343	299
Fertilizers, manufactured, phosphatic:			
Thomas slag, gross weight	1,036	971	733
Gypsum and anhydrite, crude—metric tons	3,570	4,819	1,650
Quartz, quartzite, and glass sand—do	31,920	29,560	18,115
Stone, sand and gravel, n.e.s.:			
Sand:			
Molding	4	3	2
Other, industrial	866	1,208	729
Stone:			
Building stone:			
Rough cut—thousand cubic meters	11	27	[2] 371
Facing—thousand square meters	1	1	1
Cut stone, crude—cubic meters	35	212	86
Crushed stone	475	NA	NA
Dolomite, n.e.s	494	475	387
Paving blocks—thousand pieces	13	13	6
Slate slabs—thousand square meters	10	5	6
MINERAL FUELS AND RELATED MATERIALS			
Manufactured gas—million cubic feet	78,860	[e] 60,000	[e] 60,000

[e] Estimate. [p] Preliminary.

[1] In addition to the commodities listed, Luxembourg also produces refractory clays, and manufactured phosphatic fertilizers other than Thomas slag, but data are not published and information is inadequate to make reliable estimates of output levels.

[2] Thousand metric tons.

The Mineral Industry of Bolivia

By Orlando Martino [1]

Bolivia's economic performance in 1976 was marked by recovery from the recession that began in late 1975 and continued through the first half of 1976. The increase in Bolivia's gross domestic product (GDP), as indicated in the following tabulation in million dollars,[2] represented the fifth consecutive year of growth.[3] Inflation,

	1975	1976	Percent change
GDP at current prices	2,154	2,628	+22
GDP at constant 1970 prices	801	859	+7

at 12%, was unchanged from the rate of 1975.

The Bolivian mining industry participated in the economic recovery and accounted for about 11% of the GDP. The value of mineral exports increased 20% in 1976 to $379 million. Exports of minerals and mineral fuels (crude oil and natural gas) represented 89% of total exports, indictating the important role of minerals as an earner of foreign exchange for Bolivia.

Three State-owned organizations dominated the mineral industry. The Corporación Minera de Bolivia (COMIBOL), as operator of 90 mines grouped under 12 mining companies, was the leading producer and exporter of tin, zinc, lead, silver, bismuth, and cadmium. COMIBOL contributed 61% of all mineral exports. Yacimientos Petrolíferos Fiscales Bolivianos (YPFB), the Bolivian national oil company, was the principal producer and exporter of oil and natural gas. Empresa Nacional de Fundiciones (ENAF) was concerned with metallurgical programs in line with the Government's policy of maximizing processing of concentrates in Bolivia.

Besides the State-owned organizations, in the private sector there were medium-size miners (34 in early 1976 compared with 19 in 1972) and small miners grouped under Cámara Nacional de Minería (Small Miners Association). In 1976, the World Bank granted a $10 million loan to the Banco Industrial S.A. for medium miners and industrial projects and a $12 million loan to be channeled in part through Banco Minero de Bolivia (BAMIN), the State mining bank, for increasing the productivity of the small mining sector.

Mining cooperatives were officially recognized during 1976 as a distinct group in the mining sector. The cooperatives were primarily involved in tin and gold operations. The price situation forced copper and sulfur cooperatives in Potosí to operate on a small scale.

About 79,000 persons were employed in the mining sector, representing 3.6% of total employment. COMIBOL maintained its dominant position, accounting for 32% of mining employment, followed by small mines (29%), mining cooperatives (29%), and medium mines (10%). YPFB employed 4,700 persons in its oil and gas operations.

Government Policies and Programs.—The year 1976 marked the beginning of Bolivia's 5-year national development plan for the period ending in 1980. As part of this plan, the Government aims at diversification of mining and considerable expansion of smelting and refining capacity.

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Bolivian pesos ($b) to U.S. dollars at the rate of 20$b = US$1.00.

[3] U.S. Department of Commerce. Foreign Economic Trends, Bolivia. No. 77-128, September 1977.

Planned public sector mining and refining investment for the 5-year period amounting to $450 million was distributed as follows: ENAF 54%, COMIBOL 25%, and Servicio Geológico de Bolivia (GEOBOL) 7%. The Ministry of Mines and Metallurgy was preparing a mining development law covering taxation, expanded exploration, and methods to attract new investment in mining. The proposed legislation was based partly on the 1975 taxation study by the Harvard Institute for International Development. The Government was especially interested in attracting foreign investment in the development of its lead, zinc, silver, and tungsten resources. By yearend, neither the proposed mining law nor the $1.2 million mineral exploration fund had been approved. The proposed fund was based on a feasibility study by the U.S. Geological Survey.

Following the miners strike in June, Bolivia's military forces occupied the mining areas, arresting and exiling the leaders of the Federation of Mine Workers.

By yearend, Bolivia had not ratified the fifth International Tin Agreement. Bolivia advocated a systematic and periodic review of buffer stock floor and ceiling tin prices. Priority matters of the International Tin Council (ITC) for Bolivia concerned changes in the voting system and compulsory contributions by consumers to the ITC buffer stock.

GEOBOL operated as the counterpart Government agency for exploration programs with technical assistance from foreign and international agencies. The Cordillera Exploration Project, financed by the United Nations Development Program (UNDP), COMIBOL, and GEOBOL, was completed in 1976 and final reports were under preparation. The Institute of Geological Sciences of London began an exploration project with GEOBOL in mid-1976 covering the Brazilian pre-Cambrian shield in eastern Bolivia. Phase I of the Geo-Mineralogic Apolo Project financed by West Germany and executed by GEOBOL with the technical assistance of the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) was partially completed. Phase I involved geochemical reconnaissance of an area north of La Paz. Phase II will focus on an evaluation of the gold deposits of the middle Tuichi River.

The Government issued Supreme Decree 12879 which provided a new schedule of export taxes (regalias) for minerals exported from Bolivia after January 1, 1976. The new schedule covers tin, antimony, copper, lead, zinc, and tungsten, and specifies tax rates that are lower than those of the previous schedule.

PRODUCTION

The production of antimony, tin, and tungsten showed important increases and provided the basis for the recovery of mineral production during 1976 relative to the depressed level of 1975. The sharp increase in manganese output reflects initial exploitation of the Mutún deposit. Natural gas output increased 12%. Copper and gold output dropped, and the declining trend for sulfur continued. Production problems caused a decline in cement output. Table 1 shows the role of COMIBOL in mineral production.

Table 1.—Bolivia: COMIBOL's total mineral output

(Metric tons of fine content unless otherwise specified)

Commodity	1974	1975	1976
Bismuth	696	580	536
Cadmium	135	138	140
Copper	3,667	3,405	3,415
Gold ---troy ounces---	531	412	354
Lead	13,971	11,085	12,556
Silver ---thousand troy ounces---	5,080	4,887	4,951
Tin	20,061	20,965	20,626
Tungsten	977	1,079	1,121
Zinc	32,969	31,718	34,046

Table 2.—Bolivia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS [2]			
Antimony:			
Mine output, metal content	13,060	11,796	15,307
Metal [3]	--	131	1,744
Arsenic, mine output, white arsenic equivalent [3]	11	10	5
Beryllium: Beryl ore, 10% to 12% BeO [3]	--	--	[e] 30
Bismuth:			
Mine output, metal content	613	611	612
Metal [3]	575	584	263
Cadmium, mine output, metal content [4]	135	138	142
Copper, mine output, metal content	8,130	6,391	4,787
Gold, mine output, metal content [5] troy ounces	43,272	53,218	28,797
Iron ore:			
Gross weight [3]	--	31,584	--
Metal content [3]	--	19,740	--
Lead:			
Mine output, metal content	17,449	15,216	16,368
Metal including alloys [3]	21	--	--
Manganese ore:			
Gross weight	513	1,236	12,265
Metal content	154	371	3,680
Silver, mine output, metal content thousand troy ounces	5,385	5,470	5,091
Tin:			
Mine output, metal content	[e] 29,498	[e] 25,590	29,812
Metal including alloys	7,049	7,533	9,185
Tungsten, mine output, metal content	2,821	2,036	3,039
Zinc, mine output, metal content	48,221	47,114	48,546
NONMETALS			
Barite [3]	3,851	1,805	917
Cement, hydraulic [7]	202,298	226,251	NA
Feldspar-related minerals, sodalite [3]	--	--	2
Gypsum, crude [8]	3,251	570	--
Lime, hydrated [8]	--	85	--
Magnesite [3]	--	60	80
Mica [3]	--	12	--
Stone: Calcite [3]	83	85	--
Sodium sulfate [3]	--	70	--
Sulfur, elemental	41,769	21,921	14,881
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural:			
Gross production million cubic feet	144,128	137,297	153,952
Marketable production do.	60,539	60,092	71,442
Natural gas liquids:			
Natural gasoline thousand 42-gallon barrels	78	86	43
Liquefied petroleum gas do.	65	144	[e] 150
Petroleum:			
Crude do.	16,603	14,732	14,856
Refinery products:			
Gasoline do.	2,332	3,215	2,473
Jet fuel do.	227	330	406
Kerosine do.	919	1,111	1,078
Distillate fuel oil do.	919	1,144	1,363
Residual fuel oil do.	1,124	1,263	1,353
Lubricants do.	68	74	76
Other:			
Liquefied petroleum gas do.	125	198	1,007
Unspecified do.	2	4	
Refinery fuel and losses do.	216	26	190
Total do.	5,932	7,365	7,946

[e] Estimate. [p] Preliminary. NA Not available.

[1] In addition to the commodities listed, salt and a variety of construction materials such as clays, stone (crushed, broken, and dimension), and sand and gravel are produced, but information is inadequate to permit formulation of reliable estimates of output levels.

[2] Unless otherwise specified, data for 1974 and 1975 represent the sum of production by COMIBOL and exports by medium and small mines; and data for 1976 are actual output by COMIBOL and medium and small mines.

[3] Actual production not reported; data presented are total national exports and are regarded as being virtually equal to total production.

[4] Contained in zinc concentrates produced by COMIBOL; not recovered in elemental form in Bolivia.

[5] COMIBOL output plus sales by placer mines. (Medium and small mines cannot legally export gold.)

[6] Sum of COMIBOL production; COMIBOL purchases from lessees in COMIBOL-owned mines and from other producers; sales of medium and small mines to ENAF smelter; and exports of medium and small mines.

[7] Sales by cement plants.

[8] Actual production not reported; data presented are total national exports, however, total national production is believed to be considerably larger, with that portion of output not exported being consumed in local markets. Available information is inadequate to estimate reliably the level of domestic consumption.

TRADE

Bolivia was a major world exporter of tin, tungsten, antimony, and bismuth, and an exporter of lesser importance of zinc, silver, lead, petroleum, and natural gas. Bolivian mineral and mineral fuel exports in 1976 regained the high level attained in 1974.

Bolivia's mineral trade, shown in table 3, showed a decreasing dependence on tin and the increasing importance of petroleum and natural gas for export earnings. Tin exports were 37% of the total in 1976 compared with 50% in 1970; petroleum and natural gas exports increased its share of total export earnings from 6% to 27% during the same period. The increase in the value of tin exports resulted from increases in both volume and price of tin. The inauguration of the Vinto antimony smelter accounted for the increase in the value of antimony exports.

Argentina continued as the chief market for Bolivian exports of petroleum and natural gas. The United States and Ecuador were the next most important importers of crude oil from Bolivia. Brazil, Chile, and Peru were no longer purchasing the higher-priced Bolivian oil.

In September an economic delegation from Argentina visited Bolivia and agreed to negotiate the purchase of an additional 4 million cubic feet of natural gas per day. Argentina promised to consider studying the purchase of Bolivian iron ore once the Mutún feasibility study is completed.

The second meeting of the Brazil-Bolivia Committee on Economic and Technical Cooperation (COBBET), originally scheduled for April 1976, was repeatedly postponed during the year. The first meeting of COBBET in Santa Cruz in December 1975 outlined several major projects for joint development. The chief projects were the $350 million gas pipeline from Santa Cruz, Bolivia, to Corumbá, Mato Grosso, Brazil, and the construction of an industrial complex in southeast Bolivia that would utilize the gas and iron ore resources.

Government measures restrained the growth of imports to 5% in 1976, resulting in a small trade surplus.

Table 3.—Bolivia: Leading mineral and mineral fuel exports

(Million dollars, c.i.f. value)

Commodity	1973	1974	1975	1976	Percent of total, 1976	Percent change from 1975 to 1976
Minerals:						
Tin	131.0	229.8	181.1	227.9	37	+26
Zinc	26.0	37.3	40.3	39.1	7	−3
Tungsten	11.1	20.9	22.3	34.8	6	+56
Antimony	17.3	29.0	17.1	31.4	5	+84
Silver	12.6	26.8	28.5	24.3	4	−15
Other	27.9	42.2	24.9	21.0	3	−16
Total	225.9	386.0	314.2	378.5	62	+20
Mineral fuels:						
Petroleum	48.9	163.9	114.4	112.6	18	−2
Natural gas	18.1	29.2	42.4	54.6	9	+29
Total	67.0	193.1	156.8	167.2	27	+7
Other exports	39.7	71.4	57.7	65.5	11	+14
Grand total	332.6	650.5	528.7	611.2	100	+16

Table 4.—Bolivia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS [1]			
Antimony:			
In ore and concentrate	13,060	11,796	United States 8,056; Switzerland 3,127; Brazil 275; Argentina 251.
As metal and in alloys	--	131	United States 63; Japan 56.
Arsenic, white	8	10	NA.
In ore and concentrate	121	28	Belgium-Luxembourg 591.
As metal and in alloys	575	584	
Cadmium in zinc ore and concentrate	110	156	All to United States.
Copper in ore and concentrate	7,917	5,991	Japan 5,536.
Gold metal, troy ounces	NA	NA	
Iron in ore and concentrate	--	19,740	NA.
Lead in ore and concentrate	19,353	17,665	United States 12,963; Argentina 3,121.
Manganese in ore	154	371	All to Argentina.
Silver in ore and concentrate, thousand troy ounces	5,769	6,547	United States 4,823; United Kingdom 707; Belgium-Luxembourg 386.
Tin:			
In ore and concentrate	28,955	18,944	United States 6,840; United Kingdom 6,739; West Germany 1,782.
In smelter products		7,497	Netherlands 1,778; U.S.S.R. 1,354; Czechoslovakia 1,192; Argentina 914.
Tungsten in ore and concentrate	r 2,583	2,551	United States 1,271; Switzerland 1,195; Netherlands 85.
Zinc in ore and concentrate	48,600	49,544	United States 31,240; Japan 12,343; Argentina 3,886.
NONMETALS			
Barite	3,851	1,805	All to United States.
Gypsum	3,251	570	NA.
Magnesite	--	60	NA.
Sodium sulfate, natural	--	70	NA.
Stone:			
Calcite	83	85	NA.
Marble	41	--	
Sulfur, elemental	41,769	21,421	All to Chile.
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural, million cubic feet	54,593	55,489	All to Argentina.
Petroleum, crude, thousand 42-gallon barrels	10,799	8,283	NA.

r Revised. NA Not available.

[1] All data on metal exports are in terms of metal content of material shipped except for arsenic, which is reported in gross weight of white arsenic.

Sources: Department of Economic Studies and Statistics. Boletin Estadistica. Nos. 24 and 36; and U.S. Embassy, La Paz, Bolivia. U.S. State Department Airgram A-86, Aug. 2, 1976.

Table 5.—Bolivia: COMIBOL's mineral exports excluding sales to ENAF

Commodity	1975		1976		Percent change	
	Quantity	Value (c.i.f.) (millions)	Quantity	Value (c.i.f.) (millions)	Quantity	Value (c.i.f.)
Tin, metric tons	[1] 14,310	$98.2	[2] 15,092	$113.0	+5	+15
Zinc, do.	33,607	27.4	33,067	26.3	-2	-4
Silver, thousand troy ounces	5,948	25.9	4,790	20.5	-19	-21
Tungsten, metric tons	1,021	8.9	1,160	12.4	+14	+39
Lead, do.	14,228	6.3	12,668	5.6	-11	-11
Copper, do.	3,005	3.6	2,853	3.9	-5	+8
Bismuth, do.	[3] 590	7.3	263	3.2	-55	-56
Cadmium, do.	156	1.3	114	.9	-27	-31

[1] Includes 1,526 tons exported under toll contract.

[2] Includes 1,747 tons exported under toll contract.

[3] Only 6 tons of bismuth was sold as concentrate; the rest was as metal.

Table 6.—Bolivia: Exports of mineral commodities [1]

Commodity	COMIBOL's percentage of total mineral exports			Purchases from cooperatives as percent of COMIBOL exports		
	1971–74	1975	1976	1971–74	1975	1976
Bismuth	94	96	85	6	--	--
Cadmium	100	100	100	--	--	--
Copper	44	50	60	4	--	--
Lead	63	85	66	4	2	2
Silver	87	91	84	6	7	3
Tin	56	76	69	17	21	20
Tungsten	36	40	36	100	100	99
Zinc	82	69	67	--	--	--
Overall percentage	53	57	61			

[1] Percent is based on gross value of mineral exports (excluding mineral fuels), including sales to ENAF.

Source: Ministry of Mining and Metallurgy; COMIBOL.

COMMODITY REVIEW

METALS

ENAF, in partnership with COMIBOL, was planning several smelting and refining plants to reduce the amount of minerals exported as concentrates. The projects located around Potosí are listed in table 7 and would comprise Bolivia's third metallurgical complex. The status of the feasibility studies on the lead-silver and zinc plants is covered under each commodity.

Antimony.—The sharp increase in the output of metallic antimony resulted from ENAF's Vinto smelter near Oruro that went into production in early 1976. Equipment was provided by SKODAEXPORT of Czechoslovakia. ENAF produced 1,430 tons of antimony and 793 tons of antimony trioxide, representing 32% and 39%, respectively, of full capacity. Two privately owned smelters, Fundestaño and Bernal, produced about 300 tons of antimony.

In 1976, there was a 33% increase in the export of antimony concentrate to 15,662 tons, most of which was supplied by medium-size miners. Exports of metallic antimony rose sharply to 1,744 tons. Total antimony reserves in Bolivia were estimated at 145,000 tons of fine content, of which measured reserves were 97,000 tons.[4]

[4] Armando Ergueta Arama. La Riqueza Minera en Bolivia (La Paz). 1976, p. 94.

Table 7.—Bolivia: Metallurgical projects of ENAF and COMIBOL

Commodity	Smelter location	Capacity		Startup date	Estimated cost (millions)
		Current	Expanded or new		
Antimony [1] metric tons	Potosí	--	[2] 5,000	1983	$28
Antimony do	Tupiza	--	5,600	NA	NA
Tin do	Vinto (Oruro)	11,500	20,000	1977	NA
Tin (low-grade sources) do	do	--	10,000	1979	49
Lead [1] do	Potosí	--	22,000	1980	NA
Silver [1] million troy ounces	do	--	6.4	1980	NA
Zinc metric tons	do	--	100,000	1983	225

NA Not available.
[1] Project will be executed in cooperation with COMIBOL.
[2] ENAF's first plant with a current capacity of 4,270 tons is located at Vinto (Oruro).

Bismuth.—With the inauguration in March 1976 of COMIBOL's refinery, Bolivia may become one of the leading world producers of refined bismuth. The refinery, located in southern Bolivia at Telamayo, had a capacity of 600 tons per year and was built by the Belgian firm Sidech PBR at a cost of $500,000. Bolivia was among the few countries that produced bismuth as a primary product from sulfide ore, although bismuth was also produced as a byproduct of copper, lead, and zinc mining operations.

Bismuth production and exports suffered in 1976 because of the large drop in European pharmaceutical consumption. Exports fell 45% to 320 tons in 1976.

Copper.—The mine output of copper has been declining sharply in recent years, and there was no prospect of any significant new production. Copper exports in 1976 decreased 22% to 4,680 tons because of the closing of the Chararilla mine of Nitto Bolivia Mining Co. Ltd., the second largest copper mine in Bolivia, which produced 44% of total exports of copper in 1975.

The Dowa Mining Co., Ltd., of Japan was preparing a feasibility study for a copper smelter which ENAF was planning to install in the Department of La Paz. The plant was scheduled to start production at the beginning of 1981 at the rate of 10,000 tons per year of fine copper.

Gold.—Gold production fell 46% in 1976. Although gold production by the cooperatives on the Tipuani River increased 16%, that of South American Placers Inc. (SAPI) and COMIBOL decreased. The cooperatives accounted for 61% of Bolivia's total production. There were again no exports of gold in 1976, as in 1975.

In May, SAPI and the Corporación de las Fuerzas Armadas para el Desarrollo Nacional (Armed Forces Development Corp.) (COFADENA) formed a joint venture to explore the COFADENA concessions on the Mapiri and Kaka Rivers. A drilling program was started and the evaluation work was expected to be completed by October 1977.

Throughout 1976, the Ministry of Mines and Metallurgy had under consideration a proposal to open the fiscal reserves to private exploration. This was thought to be a significant step for the future of gold production in Bolivia.

Iron Ore.—Bolivia did not export any iron ore in 1976 from the Mutún deposit. Supreme Decree 13059 signed in April placed iron and manganese exports under the control of the Empresa Siderúrgica Boliviana S.A. (SIDERSA).

SIDERSA and Atkins Planning of the United Kingdom continued monitoring and evaluating the feasibility study of the Mutún project by Arthur G. McKee and Co. of Cleveland, Ohio. At yearend the study was 80% complete and expected to be concluded by July 1977.

Iron ore reserves at Mutún were calculated at 600 million tons within the 2-square-kilometer area chosen as the mine site out of an estimated 48 billion tons for the 55-square-kilometer ore body. Iron ore grade increases to an average of 65% in secondary deposits and drops to an average of 50% in most of the mountain. The magnetite–hematite ratio, originally thought to be high, was found to be 1 to 5.

Iron and Steel.—After long discussions with the central Government and the regional Development Corp. of Cochabamba and Santa Cruz, SIDERSA arrived at a master plan to produce 200,000 tons per year of low carbon steel using charcoal blast furnaces and iron ore from the rich secondary deposits of Mutún. It was also planned to produce 600,000 tons per year of sponge iron by a direct reduction system using natural gas from Santa Cruz and iron ore from the primary ore deposit of Mutún. Final production targets for iron and steel output were to be defined by the McKee study.

Lead.—The production of lead concentrate rebounded from the depressed level of 1975. Lead occurs in Bolivia mainly in silver and zinc ores, but it also occurs in ores of antimony and bismuth. Deposits are located chiefly in southern Bolivia in the Department of Potosí and secondarily in the Department of La Paz. COMIBOL was the main producer with 77% of total annual production primarily from the Tatasi and Telamayo mines. Important medium miners were the companies of Alameda, Casado Hermanos, Tanera, and Tuntoco. With new mining projects scheduled to start up in late 1977, lead production in 1978 was expected to reach 28,000 tons. Lead exports

Table 8.—Bolivia: Lead exports
(Metric tons)

Year	COMIBOL	Medium mines	Small mines	Total	Value (c.i.f.) (millions)
1973	13,178	3,858	3,116	20,152	$8.3
1974	13,968	1,911	3,473	19,352	11.5
1975	14,228	2,129	1,308	17,665	7.7
1976	12,668	2,739	3,173	18,580	8.4

in recent years showed a slight declining trend.

By the end of 1976, Klockner Industries Anlagen of West Germany and Sidech PBR of Belgium had completed the feasibility study of the lead-silver smelter-refinery planned by ENAF and COMIBOL. Bolivia was expected to refine 90% of its lead-silver concentrate by 1980.

Measured and indicated lead reserves in Bolivia were estimated as follows: [5]

Sector	Measured reserves	Indicated reserves
COMIBOL	85,000	78,200
Medium mines	35,500	15,200
Small mines	4,100	15,800
Total	124,600	109,200

Manganese.—SIDERSA was developing the San Pedrito manganese bed in the Mutún ore body to produce 30,000 tons during 1977, of which 20,000 tons was already sold to Metallgesellschaft of West Germany. The balance of the Mutún ore was expected to be marketed in Brazil or Argentina. No reserve figures were available.

Silver.—Silver has been mined in Bolivia for over 500 years. Production has ranged between 4.5 million and 8.0 million troy ounces in the twentieth century. Silver ranks after tin, zinc, and tungsten in value.

Silver production was derived mainly as a byproduct of COMIBOL's tin, lead, and zinc mining. COMIBOL's most important producer was Empresa Minera Quechisla from its Animas, Tatasi, and San Vicente mines. Exports of silver of 5.63 million troy ounces in 1976 declined 14% from those of 1975.

COMIBOL and private mining companies were planning to expand silver production. The startup in late 1976 of New Jersey Zinc Co.'s Huari-Huari zinc mine would add between 300,000 and 500,000 troy ounces to Bolivia's total annual silver output. The startup of the S. J. Groves Cascabel lead-silver mine in 1978 would add an additional 500,000 troy ounces per year. Empresa Minera Unificada S.A. (EMUSA) was planning to open a silver mine in Toldos, Sud Lípez, in 1978.

Tin.—From 1894, when tin was first exported, to 1976, exports totaled 2.12 million tons. Bolivian tin production in 1976 recovered from the slump of 1975, when the industry was constrained by export quotas imposed by the ITC and lower world prices. The price of tin began rebounding in February 1976, and by December was at $4.00 per pound. ITC export quotas were lifted in June. Tin exports from Bolivia increased to 30,355 tons, 15% over those of 1975. Much of the increase was from stocks created by 1975 production. Production, exports, and sales to ENAF of tin concentrate in tons were as follows:

Sector	Production	Exports	Sales to ENAF
COMIBOL	20,626	15,092	6,011
Medium mines	7,188	2,762	4,097
Small mines	NA	2,632	--
Total	NA	20,487	10,108

NA Not available.

COMIBOL's tin production decreased 2%. ENAF's production of electrolytic tin and alloys totaled 9,185 tons in 1976.

COMIBOL's tin mining costs in 1976 showed a sharp increase of 27% over those of 1975 mainly as a result of wage increases, increases in financing costs, and higher prices on imported machinery, equipment and spare parts. Royalties, based on market prices and volume of exports, also increased 31%. A summary of COMIBOL's tin mining and marketing costs is given in table 9.

The average rate of recovery of tin from ore by COMIBOL and the medium mines was about 50%. To help improve recovery,

[5] Page 95 of work cited in footnote 4.

Table 9.—COMIBOL's tin mining and marketing costs
(Dollars per pound)

Year	Mining costs	Export taxes	Royalties	Handling, transport, insurance, smelting	Total cost on market [1]	Average London Metal Exchange price
1971	1.10	0.14	--	0.31	1.54	1.59
1972	1.03	.18	0.08	.35	1.64	1.71
1973	1.05	.37	.23	.48	2.13	2.18
1974	1.60	.24	.81	.59	3.24	3.71
1975	1.59	.21	.55	.67	3.02	3.11
1976 [2]	2.02	.28	.72	.78	3.80	3.40

[1] Data may not add to totals shown because of independent rounding.
[2] 1976 costs are provisional.

COMIBOL was expected to begin concentrating tin by volatilization in a U.S.S.R.-built plant in April 1976. COMIBOL was also planning to install preconcentration and flotation plants at its Colquiri, Caracoles, and Huanuni mines.

The Playa Verde alluvial tin deposit near Huanuni was to be jointly exploited by COMIBOL and London Tin in a $10 million dredging project.

Bolivia continued to increase the amount of tin smelted in the country. ENAF started building a tin smelter at Vinto for low-grade materials. The smelter is scheduled to start operation in 1979. Fundestaño, the largest private smelter, was also increasing its capacity so that by 1980 Bolivia would be able to refine nearly all the projected 1980 production of tin concentrate.

Tungsten.—In terms of export value, tungsten ranked third in importance as a nonfuel mineral export after tin and zinc. In 1976, the sharp increase in production of tungsten, primarily from wolframite, ranked Bolivia as the third largest producer on a worldwide basis after the People's Republic of China and the U.S.S.R. Bolivian reserves of metallic tungsten were estimated at 40,000 tons, about 2% of the world total.

In response to record price levels, exports by the three mining groups increased as follows:

Sector	Percent of total production in 1976	Exports (metric tons) 1975	1976	Percent change
Medium mines	48	1,202	1,575	+31
COMIBOL	37	1,021	1,160	+14
Small mines	15	328	543	+66
Total	100	2,551	3,278	+28

As prices improved during the year, many small miners went into tungsten operations.

Bolivia was active in the United Nations Conference on Trade and Development (UNCTAD) Committee on Tungsten and was working with other producer countries in trying to form an international organization of tungsten producers and consumers to stabilize prices. A Bolivian was president of the Primary Tungsten Association, an association of tungsten-producing companies.

Uranium.—Although Bolivia has been explored for uranium since 1950, only recently have systematic exploration and advanced techniques been used. The only known deposit of minable size is owned by the Comisión Boliviana de Energía Nuclear (COBOEN), established in 1960. The deposit is located at Cotaje, south of Lake Poopó, with reserves of about 500 tons of U_3O_8. The Cotaje deposit was being planned as the source of ore for the pilot plant to be completed in May 1977 by the Argentines. Initial production of yellowcake was scheduled for July 1977.

Only one foreign company had an exploration contract with COBOEN. In June 1976, the Italian oil company AGIP began drilling around Corocoro west of La Paz under a contract signed in July 1974 covering four areas in separate regions of Bolivia. Negotiations were in process between COBOEN and a French company to explore large tracts in the pre-Cambrian shield area in eastern Bolivia.

Zinc.—A large increase in output of up to 80,000 tons was projected for 1977. The increased production was to come from: (1) the startup in late 1976 of the Huari-Huari mine north of Potosí operated by

New Jersey Zinc, (2) improved recovery from marmatite flotation at the Colquiri mine of COMIBOL, and (3) the completion of the Enrique shaft at COMIBOL's Matilde mine. COMIBOL's share of zinc output was expected to decrease from 67% in 1975 to 61% in 1977.

Klockner Industries Anlagen of West Germany was completing a feasibility study on a smelter planned by ENAF using a new process (developed by ENAF and Klockner) to recover zinc from slag that may run as high as 20% zinc content from the complex marmatitic ores mined in Bolivia.

NONMETALS

Asbestos.—A prospecting project financed by the United Nations Industrial Development Organization (UNIDO) and UNDP for the evaluation of the asbestos and magnesite deposits of Chaparé-Cochabamba was concluded in 1976, and final reports were under preparation. The objective of the project was to increase reserves for the asbestos beneficiation plant built by the United Nations outside of Cochabamba.

Barite.—The Baroid Div. of NL Industries, Inc., in a joint venture with Mosamar of Bolivia, was constructing a barite and bentonite beneficiation plant in Oruro. The plant was scheduled for completion in early 1977. Barite is found near Oruro, and bentonite is found near Río Mulatos further south on the Bolivian Altiplano. Barite production was to be 10,000 tons per year, and bentonite production was to be 8,000 tons per year.

Lithium.—During 1976, a French-Bolivian team confirmed the presence of large high-grade deposits of lithium and potassium in the Salar de Uyuni and other smaller salt lakes to the south of Uyuni. The lithium is contained primarily in brines, salt crusts, and interbedded clays.

MINERAL FUELS

Natural Gas.—Production of natural gas by YPFB rebounded from the depressed level of 1975, as shown in table 10. There were 247 producing wells in 13 gasfields in 1976.

YPFB exports of natural gas to Argentina in 1976 were at the level of the previous year, but revenues increased 29% to $54.6 million. In January 1976, a new gas price of $0.82 per thousand cubic feet was negotiated with the Argentine Government, compared with the price of $0.35 prevalent before the renegotiation of late 1974. During 1976, Bolivia negotiated a new sales agreement with Argentina to increase gas exports by 50% beginning in 1979. If the 640-kilometer gasline to Brazil, under negotiation, is completed by 1980, gas exports would reach 470 million cubic feet per day and produce revenues of $214 million per year at the projected price of $1.25 per thousand cubic feet of gas.

The Río Grande, La Peña, and Los Monos gasfields had the greatest increase in production, and the Camiri gasfield had the greatest decrease.

Table 10.—Bolivia: Distribution of natural gas production

(Million cubic feet)

	1975	1976	Percent of total, 1976	Percent change
Injected	60,615	71,442	46	+18
To Argentina pipeline	55,099	55,489	36	+1
Vented and flared	16,590	20,744	13	+25
Local consumption	4,992	6,277	4	+26
Total[1]	137,297	153,952	100	+12

[1] Data may not add to totals shown because of independent rounding.

Natural gas resrves at yearend were estimated to range between 4.7 and 5.0 trillion cubic feet. The largest gas reserves were located north and northwest of Santa Cruz. The Tita Field, discovered by Occidental Boliviana Inc. in 1976, was estimated to have 180 billion cubic feet of gas reserves. The Yapacani, Palometas, and Palacios Fields were being held in reserve for the planned gasline to Brazil. At 1976 rates of consumption, natural gas reserves, which are more substantial than oil reserves, would last for 62 years.

Petroleum.—Data on Bolivia's production, consumption, and trade of petroleum are given in tables 11 and 12. Bolivia received a premium price for its light sulfur-free oil. The average price per barrel was $13.95 in 1976 compared with $13.45 in 1975. Argentina, by way of the pipeline from Santa Cruz to Yacuiba, was the major market.

There were four oil discoveries in 1976: A large field by Occidental (at Tita) and three smaller fields by YPFB (at Cambeiti, Espejos, and Montecristo). The new fields were expected to come onstream in 1978. Projected output from the four fields for 1978, 1979, and 1980 were, respectively, 4.9 million, 10.6 million, and 14.6 million barrels. Thus, by 1980 Bolivia's national plan projected a petroleum output of 180,000 barrels per day compared with current production of 40,000 barrels per day.

Domestic consumption of petroleum was 20,000 barrels per day. The price of gasoline in Bolivia, despite the substantial increase in late 1975, was one of the lowest in South America. Local fuel oil consumption was expected to rise sharply in the next 3 years to meet the needs of COMIBOL's tin volatilization plant in 1978 and additional tin and other smelters scheduled for 1977. Some plants may have to switch to natural gas supplies eventually, but to date no specific conversion plans were underway.

Exploration was at a relatively high level in 1976. Drilling increased 238% over that of 1975, and four discoveries were made, as previously detailed. Only one operations contract, with AMOCO, wes signed during 1976 bringing the total number of signed contracts to 17 since the General Hydrocarbons Law of March 1972. At yearend, only 3 of the 17 exploration groups were active: Occidental, Phillips Petroleum Co., and Tesoro Bolivia Petroleum Co. To maintain the pace of exploration, YPFB was considering opening up areas previously reserved to the Government, except where it has its own specific drilling plans.

Bolivia's proven petroleum reserves at yearend totaled 176 million barrels, a 21% increase over those of 1975.

Field	Reserves (million barrels)	
	Proven	Estimated, under evaluation
Established fields	152	--
Cambeiti	15	--
Espejos	9	--
Montecristo	--	90
Tita	--	60–100
Total	176	XX

XX Not applicable.

YPFB operated five refineries ranging in capacity from 600 barrels to 13,000 barrels per day with a total capacity of 40,300 barrels per day. A 5,000-barrel-per-day topping plant was inaugurated at the Santa Cruz refinery in 1976. Construction continued by McKee on expanding the refineries of Cochabamba and Santa Cruz to 25,000 and 15,000 barrels per day, respectively. By late 1978, Bolivia's total refinery capacity would be 75,000 barrels per day, which would exceed current oil output.

Table 11.—Bolivia: Crude petroleum production by YPFB, by field

(Thousand 42-gallon barrels)

Field	1970	1971	1972	1973	1974	1975	1976
Río Grande	--	3,459	3,529	4,856	4,562	4,578	5,412
Monteagudo	1,682	3,046	3,583	3,465	2,978	2,471	1,867
La Peña	--	90	2,132	2,770	2,582	2,069	2,824
Caranda	--	3,920	3,172	2,625	2,034	1,527	1,345
Colpa	--	787	1,899	1,892	1,700	1,363	1,029
Camiri	1,076	958	806	695	602	566	559
Tatarenda	381	729	552	445	301	235	241
Caigua	--	--	--	273	1,651	1,568	1,319
San Alberto	1	1	114	83	70	58	52
Bermejo-Toro	219	173	141	126	100	83	58
Camatindi	36	30	26	28	20	28	31
Other	[1] 5,425	13	12	7	3	185	[2] 119
Total [3]	8,820	13,206	15,967	17,266	16,603	14,732	14,856

[1] Includes 6,000 barrels by YPFB from the El Tigre Field and 5,419,000 barrels by the Bolivian Gulf Oil Co. from the Caranda, Colpa, and Río Grande Fields.
[2] Includes production of Tigre, Guairuy, Buena Vista, Cambeiti, and Los Monos Fields.
[3] Data may not add to totals shown because of independent rounding.

Table 12.—Bolivia: Petroleum production, consumption, and exports

(Thousand 42-gallon barrels)

Year	Production	Percent change from previous year	Consumption	Percent change from previous year	Exports	Percent change from previous year
1966	r 5,874	NA	3,471	NA	r 1,887	NA
1967	r 14,592	+148	3,805	+9.6	r 10,528	+457.9
1968	r14,973	+3	4,234	+11.3	r 10,703	+1.7
1969	r 14,757	−1	4,433	+4.7	10,068	−5.9
1970	8,820	−40	4,565	+3.0	r 3,662	−63.6
1971	13,446	+52	4,955	+8.5	8,447	+130.7
1972	15,967	+19	5,201	+5.0	10,945	+29.6
1973	17,266	+8	5,533	+6.4	11,844	+8.2
1974	16,603	−4	5,932	+7.2	10,799	−8.8
1975	14,732	−11	6,673	+12.5	8,283	−23.3
1976	14,856	+1	7,946	+19.1	8,066	−2.6

r Revised. NA Not available.

The Mineral Industry of Brazil

By Orlando Martino [1]

Brazil's gross domestic product (GDP) grew 9.2% in real terms in 1976 to $131 billion,[2] while per capita income increased to $1,190. This impressive growth was accompanied by inflation of 46.3%, the highest rate in 12 years.

The Brazilian mineral industry represented only a small part of the country's economy because of the predominant roles played by agriculture and manufacturing. Although the mineral sector accounted for less than 2% of Brazil's GDP, it was responsible for 17% of the country's total exports. Production of minerals and mineral fuels in 1976 was valued at $2.3 billion, a 6.8% increase over that of 1975, compared with the average 13.1% increase of the post-World War II period. The percentage distribution of the total value of mineral production, by mineral group, follows:

	Percent of total value		Percent change of value
	1975	1976	
Metals	38.1	38.0	+6
Diamond and gem stones	1.6	1.1	--
Nonmetals, n.e.s	19.9	26.3	+40
Mineral fuels	40.4	34.6	−10

The nonmetals group, made up of some 40 commodities, had the highest rate of growth in value. Of the total value of mineral output of $2.3 billion, 10 commodities accounted for 86.3%, as follows: Petroleum 30.5%, iron ore 28.5%, limestone 7.5%, crushed rock 4.6%, manganese 3.6%, clays 3.1%, coal 2.8%, marine salt 2.8%, tin 1.5%, and pyrochlore 1.4%.

Government Policies and Programs.—In its effort to reduce the high rate of inflation, the Government in November announced a cutback of $2.8 billion in the public investment budget. By the end of 1976 it was not clear what impact this would have on the production goals for the mining industry as outlined in the Second National Development Plan (1975–79).

Decree No. 574 of May 1976 issued by the Ministry of Mines and Energy established the National Energy Balance to be prepared annually. To reduce Brazil's great dependency on imports of crude oil, the Government projected a reduction in the role played by petroleum as a primary energy source and an increase in the use of Brazil's coal, hydroelectric power, and nuclear fuels. Taking advantage of a practice well-established in the past, the Government was planning a substantial increase in the production of alcohol from sugarcane and manioc to obtain a 20% mixture with gasoline nationwide by the mid-1980's. During 1976, the Government initiated sales of an alcohol-gasoline mixture with 10% to 15% alcohol in Rio de Janeiro, the States of Pernambuco and Alagoas, and the interior of São Paulo State.

As a result of increased exploration by private and Government-owned mining companies, the Departmento Nacional da Produção Mineral (DNPM) of the Ministry of Mines and Energy reported in its "Anuario Mineral Brasileiro—1977," covering 1976, substantial increases in the

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Brazilian new cruzeiros (NCr$) to U.S. dollars at the average rate of NCr$10.67 = US$1.00. During 1976, Brazil continued its policy of minidevaluations. As of December 31, 1976, the rate was NCr$12.35 = US$1.00.

measured reserves of beryllium, zirconium, tungsten, quartz, titanium, mica, coal, tin, asbestos, lithium, and chromium.

In December 1976, several relatively minor changes were made in Brazil's 1967 Mining Code, the most important of which was to require payment of the fee charged for exploration claims at the time of filing, instead of when exploration licenses are approved as was previously the case.

The legislation establishing the Companhia de Pesquisas de Recursos Minerais (CPRM) (Mineral Resources Research Company) in 1969 prohibited it from undertaking mining operations. It was restricted to calling for bids for development of the properties it discovered. A December 1976 change in that legislation, however, allows CPRM to negotiate directly with private companies on its discoveries without having to call for bids and also permits it to participate in mining activities.

PRODUCTION

Production of iron ore stagnated in 1976 following a decade of strong growth. Output of crude manganese ore was only slightly above that of the recent peak year of 1971. The upward trend in output of crude steel continued with a further increase of 10.4%, while production of ferroalloys, especially ferrocolumbium, reached record highs. Brazilian production of nonferrous metals in 1976 increased for aluminum (14%), copper (12%), lead (12%), and zinc (35%), and fell for nickel (6%) and tin (4%). Production of copper was based entirely on secondary (scrap) sources.

Output of portland cement increased 10% to 19.1 million tons, continuing the strong upward trend of the decade. Production of natural phosphates (P_2O_5 content) increased 136%, manufactured phosphates 58%, and nitrogenous fertilizers 14%. A decrease in production was notable in mica and lithium minerals.

Employment in the mining sector in 1976, including the coal industry but excluding the petroleum industry, totaled 61,100, a 10% increase over that of 1975. The iron ore and coal industries employed 11,500 (19%) and 9,900 (16%) workers, respectively.

Table 1.—Brazil: Production of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum:			
Bauxite, gross weight (dry basis)	r 710,802	802,294	826,715
Alumina	240,000	267,500	303,000
Metal, primary	126,046	121,400	139,175
Antimony, metal content	r 24	16	35
Arsenic, white	18	13	e 10
Beryllium, beryl concentrate, gross weight [2]	640	646	368
Chromium:			
Crude ore	424,339	702,167	886,514
Concentrate	88,077	154,465	132,455
Columbium and tantalum ore and concentrate, gross weight:			
Columbite and tantalite	92	100	198
Djalmaite concentrate	NA	35	24
Pyrochlore concentrate	17,878	14,605	19,003
Copper:			
Mine output, metal content	3,075	1,922	54
Metal, smelter (blister)	2,500	1,308	388
Gold—troy ounces	188,435	172,038	158,246
Iron and steel:			
Ore and concentrate (salable)—thousand tons	r 76,071	89,894	94,087
Metal:			
Pig iron, excluding ferroalloys—do	5,816	7,053	8,170
Ferroalloys (electric furnace):			
Ferrochromium	37,801	52,986	59,730
Ferrocolumbium	6,951	3,996	10,010
Ferromanganese	79,560	86,850	98,738
Ferronickel	9,852	9,646	9,971
Ferrosilicon	52,178	54,276	45,252
Ferrosilicochrome	1,803	2,304	5,880
Ferrosilicomanganese	32,626	38,828	63,843
Other and unspecified	7,146	7,052	18,479
Total	227,917	255,938	311,903
Steel:			
Crude, excluding castings—thousand tons	7,507	8,308	9,169
Semimanufactures, hot-rolled—do	5,750	6,695	7,367
Lead:			
Mine output, metal content	25,922	22,365	21,615
Metal:			
Primary	41,686	37,540	43,672
Secondary	21,114	25,184	26,575
Manganese ore and concentrate (marketable), gross weight [3]—thousand tons	1,789	2,156	1,696
Nickel:			
Mine output, metal content	3,536	3,190	5,273
Ferronickel, nickel content	2,391	2,280	2,149
Rare earth: Monazite concentrate, gross weight	1,196	1,450	1,610
Silver [4]—thousand troy ounces	527	235	20
Tin:			
Mine output, metal content	r e 4,400	r e 5,000	5,900
Metal, smelter, primary [e]	4,850	r 5,400	6,600
Titanium:			
Ilmenite concentrate, gross weight	6,743	4,596	14,615
Rutile concentrate, gross weight	146	104	128
Tungsten, mine output, metal content	r 993	1,132	e 1,160
Zinc:			
Mine output, metal content [e]	38,300	50,000	48,700
Metal, smelter:			
Primary	30,519	31,428	43,154
Secondary	5,400	8,000	7,000
Zirconium concentrate, gross weight, zircon [5]	2,518	2,925	3,058
NONMETALS			
Asbestos, fiber	61,871	73,978	92,703
Barite:			
Crude	60,715	53,675	51,238
Beneficiated	27,601	30,196	25,887
Calcite	NA	12,571	13,397
Cement, hydraulic (including pozzolanic)—thousand tons	r 14,914	17,437	19,147
Clays, n.e.s.:			
Bentonite	77,118	116,785	143,218
Kaolin:			
Crude	591,348	617,884	710,254
Beneficiated	173,669	172,834	209,704
Kyanite	752	230	256

See footnotes at end of table.

Table 1.—Brazil: Production of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS—Continued			
Clays, n.e.s.—Continued			
Other:			
Crude	2,014,723	2,385,710	3,229,053
Beneficiated	781,653	866,530	1,458,139
Diamond:			
Gem e thousand carats	127	131	38
Industrial e do	127	131	38
Total do	254	262	76
Diatomite	1,096	3,740	5,036
Feldspar and related materials:			
Feldspar, crude	97,292	76,429	85,114
Leucite	NA	2,449	10,290
Sodalite	298	650	643
Fertilizer materials:			
Crude, phosphatic:			
Gross weight, run-of-mine ore	2,680,558	2,864,664	3,256,042
P_2O_5 content, run-of-mine ore	195,688	207,812	489,617
Marketable products:			
Direct-shipping ore	15,044	35,660	4,119
Concentrates	327,274	406,030	NA
Total	342,318	441,690	NA
Manufactured:			
Nitrogenous (nitrogen content)	150,169	160,755	183,858
Phosphatic (P_2O_5 content)	387,349	515,970	813,000
Fluorspar:			
Direct-shipping ore (sales)	1,411	61	55
Beneficiated product (output)	61,551	63,919	31,105
Total	62,962	63,980	31,160
Graphite, all grades	5,544	5,260	6,018
Gypsum and anhydrite, crude	395,753	403,847	545,463
Lime e thousand tons	2,000	2,000	2,000
Lithium minerals:			
Amblygonite	171	156	185
Lepidolite	460	468	1,332
Petalite	3,569	3,697	968
Spodumene	NA	792	413
Total	4,200	5,113	2,898
Magnesite, crude, gross weight	365,661	439,466	414,612
Mica, all grades [2]	2,613	1,100	2,799
Pigments, crude (ocher)	10,309	7,490	5,957
Precious and semiprecious stones, except diamond, crude and worked: [2]			
Agate kilograms	1,519,666	2,465,994	1,929,158
Amethyst do	315,856	249,015	182,324
Aquamarine do	1,528	1,438	559
Cat's-eye value, thousands	$587	$338	$599
Citrine kilograms	24,267	24,049	24,250
Emerald do	1,963	2,293	2,991
Garnet do	1,584	307	211
Opal do	222	77	513
Ruby value	$1,283	--	$403
Sapphire kilograms	1	--	(6)
Topaz do	1,860	2,714	4,743
Tourmaline do	1,863	422	2,838
Turquoise do	51	101	(6)
Other do	389,992	436,944	742,433
Quartz crystal, all grades [2]	7,805	1,849	2,038
Salt, marine thousand tons	1,552	2,145	2,473
Silica	879	922	3,620
Sodium compounds:			
Caustic soda	206,342	241,303	257,016
Soda ash, manufactured	153,058	148,133	150,012
Stone, sand and gravel:			
Dimension stone:			
Granite thousand tons	r 318	16,397	56,077
Marble	103,554	130,055	105,240
Slate	1,250	1,305	1,337
Crushed and broken stone:			
Dolomite thousand tons	1,237	1,654	1,599
Limestone do	25,808	29,588	34,883
Quartz [7]	20,438	25,413	34,821

See footnotes at end of table.

Table 1.—Brazil: Production of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [p]
NONMETALS—Continued			
Stone, sand and gravel—Continued			
Crushed and broken stone—Continued			
Quartzite:			
Crude	200,766	276,382	276,036
Processed [8]	116,906	130,502	149,261
Shale	307,759	308,171	326,923
Sand—thousand tons	1,724	2,881	3,833
Sulfur, elemental, byproduct—do	9	20	30
Talc and related materials:			
Talc	155,371	154,893	151,245
Pyrophyllite	45,813	65,778	74,094
Other (agalmatolite)	104,783	81,478	53,241
Vermiculite	6	800	946
MINERAL FUELS AND RELATED MATERIALS			
Carbon black [e]	88,000	91,000	103,000
Coal, bituminous (marketable)—thousand tons	[r] 2,584	2,846	3,310
Coke:			
Metallurgical, all types—do	1,756	2,204	2,805
Gashouse—do	60	[e] 60	[e] 60
Gas:			
Manufactured, all types—million cubic feet	[r] 15,292	15,687	NA
Natural:			
Gross production—do	52,540	57,371	57,909
Marketed production—do	17,587	[e] 24,720	[e] 19,330
Natural gas liquids—thousand 42-gallon barrels	1,699	1,931	[e] 2,000
Petroleum:			
Crude—do	66,452	64,694	62,932
Refinery products:			
Gasoline—do	80,430	88,903	90,013
Jet fuel—do	9,139	10,636	11,152
Kerosine—do	4,271	3,988	4,264
Distillate fuel oil—do	68,970	77,229	87,737
Residual fuel oil—do	87,198	95,759	98,725
Lubricants—do	962	1,497	2,252
Other—do	35,758	41,112	44,546
Refinery fuel and losses—do	9,682	11,140	9,705
Total—do	296,410	330,264	348,394

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, molybdenite and bismuth are also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2] Exports.

[3] Includes nickel contained in ferronickel.

[4] Smelter and/or refined metal.

[5] Includes baddeleyite-caldasite.

[6] Less than ½ unit.

[7] Apparently includes crude quartz used to produce quartz crystal (listed separately in this table) as well as additional unreported quantities of common quartz.

[8] Produced from a portion of the crude quartzite listed; quantity of crude quartzite processed was 76,003 tons in 1974, 78,178 tons in 1975, and 61,542 tons in 1976.

TRADE

The performance of Brazil in the international economy during 1976 was marked by an overall balance-of-payments surplus and a significant reduction in the trade deficit. The trade deficit was $2.2 billion, down from the $3.5 billion deficit of 1975. This was made possible by a less than 1% increase in imports and a 17% increase in exports to $10.13 billion.

Exports from Brazil's mineral sector including ores, concentrates, common metals, semimanufactures, crude petroleum, and petroleum products totaled $1.72 billion or 17% of total exports. Exports of iron ore valued at $995 million represented 58% of mineral exports, followed by crude petroleum and derivatives, $331 million; steel and ferroalloys, $248 million; manganese, $66 million; gem stones and diamond, $22 million; tin, $15 million; and columbium-tantalum, $13 million. Iron ore exports rose in importance to third place after coffee and soy products. In recent years, Brazil has displaced Sweden as the principal supplier of iron ore to West Europe and has displaced India as the second largest supplier to Japan.

Following are Brazilian exports of particular significance to the United States:

Commodity	Percent of U.S. imports from Brazil in 1976	Brazil's rank as supplier
Quartz crystal	98	1
Lithium	82	1
Columbium	68	1
Beryllium	48	1
Manganese ore	40	1
Mica, sheet	17	2
Iron ore	12	3

Out of a total of $12.28 billion of imports by Brazil in 1976, minerals and mineral fuels accounted for $5.63 billion or 46%. Imports of crude petroleum and derivatives alone represented $4.21 billion or 34%. Steel and ferroalloys were the next most important imports valued at $568 million, followed by fertilizer materials, $268 million; coal, $222 million; copper, $219 million; aluminum, $110 million; tin, $49 million; zinc, $42 million; sulfur, $42 million; and silver, $20 million. The value of crude oil imports increased 20% and petroleum derivatives 61%.

The tonnage of steel and ferroalloy imports decreased 61% from that of 1975. However, Brazil continued to be heavily dependent on imports to meet the demands of its expanding economy. Brazil's dependence on foreign resources for domestic consumption was: Aluminum 34%, asbestos 29%, copper 80%, lead 11%, sulfur 96%, zinc 49%, phosphatic fertilizers 87%, nitrogenous fertilizers 80%, potassic fertilizers 100%, coal 57%, and petroleum 82%. Silver imports increased sharply over those of 1975.

In February 1976, Petróleo Brasileiro S/A (PETROBRAS) established a new subsidiary, PETROBRAS Comercio Internacional S/A (INTERBRAS), to act as an international trading company to capitalize on the market experience and bargaining power of PETROBRAS.

Table 2.—Brazil: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976[1]	Principal destinations, 1975
METALS				
Aluminum:				
Bauxite and concentrate	24,192	17,777	2,738	Mainly to Argentina.
Oxide (alumina) and hydroxide[2]	4,899	1,563	NA	Argentina 844; Mexico 547.
Metal including alloys:				
Unwrought	--	14	NA	Mainly to Argentina.
Semimanufactures	367	587	NA	Chile 227; Peru 191; Paraguay 126.
Antimony metal including alloys, all forms	10	26	20	Panama 20; Uruguay 6.
Beryl ore and concentrate	640	646	368	All to United States.
Chromium, chromite	13,378	190	9,128	All to Argentina.
Columbium and tantalum ore and concentrate:				
Columbite[3]	41	29	NA	All to United States.
Tantalite	105	96	NA	United States 57; Netherlands 28.
Pyrochlore	4,344	2,895	NA	United Kingdom 820; United States 760.
Copper metal including alloys, all forms	1,242	806	547	Belgium-Luxembourg 347; Uruguay 196.
Gold metal, unworked or partly worked, all forms—troy ounces	450	418	NA	West Germany 322.
Iron and steel:				
Ore and concentrate, including roasted pyrite—thousand tons	59,439	72,522	67,138	Japan 26,963; West Germany 12,294.
Metal:				
Pig iron	252,256	510,524	NA	Argentina 136,874; Venezuela 114,619.
Sponge iron, powder, shot	276	59	NA	Mainly to Argentina.
Ferroalloys:				
Ferrochrome	26,764	34,469	47,460	United States 20,500; Canada 8,890.
Ferrocolumbium	7,467	4,135	9,155	NA.
Ferromanganese	5,245	10,080	11,028	United States 6,025; Colombia 1,660; Peru 1,010.
Ferromolybdenum	143	36	2	Spain 30; Argentina 6.
Ferronickel	2,929	3,838	1,736	All to Japan.
Ferrosilicon	5,724	4,337	13,298	United States 1,420; Romania 1,000.
Other	r 3,621	4,110	4,091	United States 2,324; West Germany 1,645.
Total	51,893	61,005	86,770	
Steel, primary forms	r 79,683	27,692	NA	Italy 12,309; Uruguay 7,805; Chile 7,577.
Semimanufactures:				
Bars, rods, angles, shapes, sections	r 108,257	65,075	NA	United States 20,706; Nigeria 19,112.
Universals, plates, sheets	r 33,201	37,376	NA	Argentina 23,738; Uruguay 9,709.
Hoop and strip	207	800	NA	Uruguay 320; Bolivia 169.
Wire	r 3,780	1,978	NA	Colombia 639; Venezuela 400.
Tubes, pipes, fittings	r 7,996	7,541	NA	Venezuela 3,017; Bolivia 916; United States 878.
Castings and forgings, rough	937	1,004	NA	Bolivia 411; United States 387; Paraguay 121.
Lead metal including alloys, all forms	(4)	2	3	Mainly to United States.
Manganese:				
Ore and concentrate—thousand tons	1,493	1,555	1,072	United States 634; Norway 351.
Oxides	272	1,179	1,071	Argentina 664; Greece 152; Colombia 125.
Mercury—76-pound flasks	(4)	(4)	--	All to Bolivia.
Molybdenum metal including alloys, all forms—kilograms	--	23	NA	Netherlands 19; Uruguay 4.
Nickel metal including alloys, all forms	1	11	4	Mainly to Argentina.

See footnotes at end of table.

Table 2.—Brazil: Exports and reexports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [1]	Principal destinations, 1975
METALS—Continued				
Platinum-group and silver metals, including alloys:				
Platinum-group ----------troy ounces--	305,592	219,750	NA	Mainly to Spain.
Silver ----------do----	1,150,416	218,368	NA	France 128,603; Spain 81,052.
Rare-earth metals:				
Ores and concentrates, except monazite-	949	849	--	United States 249; Japan 220; Austria 200.
Oxides ----------	10	3	NA	United States 2; United Kingdom 1.
Metals including alloys:				
Cerium ----------	r 169	212	NA	Belgium-Luxembourg 99; United Kingdom 61.
Other ----------	--	--	NA	
Total ----------	r 169	212	NA	
Tin:				
Ore and concentrate ----------	20	--	NA	
Metal including alloys, all forms ------	2,669	3,494	3,801	United States 1,233.
Titanium:				
Ore and concentrate ----------	r 70	63	4	Mainly to Venezuela.
Oxides ----------kilograms--	--	20	NA	All to Ecuador.
Metal including alloys, all forms-do----	--	--	NA	
Tungsten:				
Ore and concentrate ----------	r 1,382	1,411	1,044	Sweden 895; France 180; Netherlands 160.
Metal including alloys, all forms ------	(4)	25	8	Mainly to Sweden.
Zinc:				
Ore and concentrate ----------	8,525	8,510	7,042	All to France.
Oxide ----------	10	13	NA	Mainly to Bolivia.
Metal including alloys, all forms ------	r 14	92	60	Mainly to Chile.
Other:				
Ores and concentrates ----------	4,860	--	NA	
Ash and residue containing nonferrous metals ----------	25	222	NA	Netherlands 170; United States 52.
Oxides, hydroxides, peroxides of metals, n.e.s ----------	95	70	NA	France 41; Argentina 13; Chile 10.
Metals including alloys, all forms:				
Pyrophoric alloys ----------	104	12	NA	Mainly to Canada.
Waste and sweepings of precious metals ----------	2	6	NA	Mainly to Spain.
NONMETALS				
Abrasives, natural, n.e.s.:				
Emery ----------	4	1	NA	Mainly to Argentina.
Grinding and polishing wheels and stones ----------	188	340	NA	Chile 131; Colombia 63.
Other ----------	1	(4)	NA	Mainly to Mauritania.
Asbestos ----------	--	1	--	All to Chile.
Barite and witherite ----------	46	--	--	
Boron materials, oxide ----------	7	--	--	
Cement ----------	120,312	46,738	51,683	Guyana 33,800; Bolivia 7,354.
Clays and clay products (including all refractory brick):				
Crude clays, n.e.s.:				
Bentonite ----------	203	1,160	600	Mainly to Bolivia.
Kaolin ----------	3,224	2,845	815	Uruguay 1,845; Chile 1,000.
Other ----------	r 1,220	1,416	475	Mainly to Uruguay.
Products:				
Refractory (including nonclay bricks) ----------	6,867	8,772	NA	Argentina 4,967; Poland 2,448.
Nonrefractory ----------	21,099	30,472	NA	Paraguay 21,150.
Diamond:				
Gem, not set or strung --------carats--	9,630	3,875	NA	United States 1,355; Netherlands 785; Japan 265.
Industrial ----------do----	2,455	10,570	NA	Argentina 9,070; United Kingdom 1,500.

See footnotes at end of table.

Table 2.—Brazil: Exports and reexports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [1]	Principal destinations, 1975
NONMETALS—Continued				
Fertilizer materials:				
Manufactured:				
Nitrogenous	--	2,000	30	Mainly to Uruguay.
Phosphatic	2,666	100	--	All to Paraguay.
Potassic	--	--	290	
Other, including mixed	1,672	8,140	NA	Mainly to Uruguay.
Ammonia	1	121	148	Uruguay 109; Paraguay 12.
Fluorspar	31,360	11,075	202	Japan 5,500; United States 5,250.
Graphite, natural	([4])	66	195	Argentina 50; Spain 10.
Lime	r 22	38	38	Bolivia 29; Paraguay 9.
Magnesite	42,594	40,237	27,919	Argentina 8,820; Venezuela 8,120; Chile 5,260.
Mica:				
Crude, including splittings and waste:				
Lepidolite	200	4,146	1,173	NA.
Other	2,613	1,100	2,799	United States 763; West Germany 180.
Worked, including agglomerated splittings	([4])	([4])	NA	Mainly to Peru.
Pigments, mineral:				
Natural, crude	200	--	NA	
Iron oxides, processed	12	38	NA	Paraguay 27; Uruguay 10.
Precious and semiprecious stones, except diamond, crude and worked:				
Agate ---kilograms	1,519,666	2,465,994	1,929,158	Japan 926,509; United States 802,244.
Amethyst ---do	315,856	249,015	182,324	United States 69,383; West Germany 65,725.
Aquamarine ---do	1,528	1,438	559	Japan 769; West Germany 504.
Cat's-eye ---do	2	1	([5])	Mainly to Japan and United States.
Citrine ---do	24,267	24,049	24,250	West Germany 7,622; Japan 5,722.
Emerald ---do	1,963	2,293	2,991	United States 784; India 685.
Garnet ---do	1,584	307	211	Mainly to Japan.
Opal ---do	222	77	513	Australia 47; Hong Kong 16.
Sapphire ---do	1	--	([4])	
Topaz ---do	1,860	2,714	4,743	West Germany 1,133; France 456.
Tourmaline ---do	1,863	422	2,838	West Germany 181; Japan 82.
Turquoise ---do	51	101	([4])	Mainly to United States.
Other ---do	r 389,992	436,944	742,433	West Germany 185,493; Japan 69,277.
Quartz crystal:				
Electronic and optical grade	r 7,658	1,672	1,965	West Germany 421; East Germany 280.
Other	r 147	177	73	West Germany 64; Italy 54; France 34.
Salt	18	32,421	1	Mainly to Uruguay.
Sodium and potassium compounds, n.e.s	10,773	7,777	NA	Mainly to Argentina.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	49,027	25,635	NA	Italy 11,944; Japan 6,680; Spain 2,447.
Worked	2,859	8,355	NA	Italy 4,263.
Dolomite, chiefly refractory grade	1,495	558	875	All to Argentina.
Quartz and quartzite	41	192	17	Belgium-Luxembourg 100; Netherlands 89.
Sand, excluding metal bearing	101	1,934	2,763	Mainly to Paraguay.
Sulfur:				
Sulfur dioxide ---kilograms	68	--	NA	
Sulfuric acid, oleum	4	90	289	Do.
Talc, steatite, soapstone, pyrophyllite	489	209	247	Argentina 100; Colombia 60.
Vermiculite	--	1	--	All to Chile.

See footnotes at end of table.

Table 2.—Brazil: Exports and reexports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [1]	Principal destinations, 1975
NONMETALS—Continued				
Other:				
Crude	53	90	NA	All to France.
Slag, dross, and similar waste, not metal bearing:				
From iron and steel manufacture	28	15	NA	All to Argentina.
Slag and ash, n.e.s	--	--	NA	
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	3	(4)	NA	Mainly to Mexico.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	--	6	NA	Mainly to Bolivia.
Coke and semicoke of coal, lignite, peat	5	--	NA	
Hydrogen and rare gases ——kilograms	2,296	1,891	NA	Uruguay 1.
Petroleum:				
Crude and partly refined thousand 42-gallon barrels	12,102	8,079	3,209	Bahamas 6,557; Uruguay 1,156.
Refinery products:				
Gasoline:				
Aviation ——do	--	563	NA	Argentina 337; Colombia 196.
Motor ——do	175	956	NA	United States 365; Bermuda 200.
Jet fuel ——do	159	123	NA	Mainly to Peru.
Kerosine ——do	r 283	281	NA	Trinidad and Tobago 214; Pakistan 67.
Distillate fuel oil ——do	816	2,975	NA	Argentina 1,945; United States 321.
Residual fuel oil ——do	1,701	2,156	NA	United States 1,491; Uruguay 315.
Lubricants (including grease) do	(4)	(4)	NA	Mainly to Paraguay.
Other:				
Liquefied petroleum gas do	169	804	NA	Argentina 497; Uruguay 195.
Mineral jelly and wax do	(4)	3	NA	Mainly to Peru.
Bitumen ——do	9	71	NA	Bolivia 35; Mauritania 30.
Bituminous mixtures ——do	4	1	NA	Mainly to Bolivia.
Pitch ——do	12	15	NA	All to Argentina.
Petroleum coke ——do	--	5	NA	Bolivia 3; Paraguay 2.
Not specified ——do	65	32	NA	Venezuela 22; Italy 10.
Total ——do	r 3,393	7,980	NA	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	--	116	NA	Argentina 79; Uruguay 20; Paraguay 16.

r Revised. NA Not available.
[1] DNPM. Anuario Mineral Brasileiro—1977. 282 pp.
[2] Includes alumina gel.
[3] Includes some tantalum.
[4] Less than ½ unit.
[5] Quantity not available. Value was $599,000.

Table 3.—Brazil: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [1]	Principal sources, 1975
METALS				
Aluminum:				
Bauxite and concentrate	15,120	12,988	14,017	Guyana 8,342; United States 3,745; Japan 900.
Oxide (alumina) and hydroxide	1,930	10,674	3,335	Jamaica 10,000; West Germany 431.
Metal including alloys:				
Scrap	5,593	4,182	4,033	United States 2,777; West Germany 493.
Unwrought	81,388	64,848	57,783	Canada 12,398; France 10,180; Norway 8,258.
Semimanufactures	r 16,626	12,022	NA	United States 5,955; France 1,644.
Antimony:				
Ore and concentrate	1,738	1,597	1,721	Bolivia 668; Thailand 531; Chile 204.
Metal including alloys, all forms	209	47	129	West Germany 19; Belgium-Luxembourg 15.
Arsenic:				
Trioxide, pentoxide, acids	851	749	1,353	France 337; West Germany 190; Mexico 149.
Metal including alloys, all forms	[2] 44	17	38	Sweden 11; Japan 3.
Beryllium metal including alloys, all forms—kilograms	([3])	([3])	NA	All from United States.
Bismuth metal including alloys, all forms	26	21	NA	Mexico 13; Netherlands 5.
Cadmium metal including alloys, all forms	176	74	NA	Mexico 58; Peru 8; West Germany 7.
Chromium:				
Chromite	30,686	9,300	12,232	Philippines 5,000; Republic of South Africa 4,084.
Oxide and hydroxide	394	113	438	West Germany 40; Poland 30; United States 23.
Metal including alloys, all forms	39	18	35	Japan 10; United States 6.
Cobalt:				
Oxide and hydroxide	82	50	93	Belgium-Luxembourg 37; United Kingdom 10.
Metal including alloys, all forms	198	148	289	Belgium-Luxembourg 100; United States 39.
Columbium and tantalum: Tantalum metal including alloys—kilograms	46	52	NA	Mainly from United States.
Copper:				
Copper sulfate	9,693	2,212	3,718	Chile 1,356; Mexico 335; United Kingdom 269.
Metal including alloys:				
Scrap	4,573	215	266	United States 188; Panama 19.
Unwrought	131,903	127,946	150,552	Chile 42,066; United States 28,508; Zaire 17,650.
Semimanufactures	3,048	2,350	2,001	United States 714; West Germany 480.
Gold metal, unworked or partly worked—troy ounces	47,133	111,788	126,995	United States 58,643; United Kingdom 27,682.
Iron and steel:				
Ore and concentrate	52	17	7	Republic of South Africa 9; United States 7.
Metal:				
Scrap	37,306	17,587	2	United States 11,196; Surinam 3,452; Canada 2,747.
Sponge iron, powder, shot	7,987	4,207	NA	United States 3,089; West Germany 821.
Ferroalloys	14,875	24,226	2,439	United States 12,409; Surinam 3,452; Canada 2,771.
Steel, primary forms	r 641,252	860,011	NA	Japan 344,831; Italy 198,954.

See footnotes at end of table.

Table 3.—Brazil: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [1]	Principal sources, 1975
METALS—Continued				
Iron and steel—Continued				
Metal—Continued				
Semimanufactures:				
Bars, rods, angles, shapes, sections	658,082	329,415	NA	Japan 102,814; West Germany 68,575; France 24,372.
Universals, plates, sheets thousand tons	2,549	1,288	NA	Japan 673; West Germany 153; United States 101.
Hoop and strip	94,326	43,118	NA	West Germany 21,761; Japan 9,929; United States 4,449.
Rails and accessories	99,499	224,024	NA	Japan 74,577; Poland 71,432; United States 68,551.
Wire	44,985	22,866	NA	Japan 9,101; West Germany 4,393; Argentina 3,321.
Tubes, pipes, fittings	r 106,494	125,781	NA	Japan 36,361; West Germany 35,874; Italy 27,424.
Castings and forgings, rough	3,005	6,723	NA	West Germany 4,087; Belgium-Luxembourg 2,023.
Ingots, high carbon and alloy steel	1,553	783	NA	Canada 505; Japan 205.
Lead:				
Oxides	1,292	678	1,793	Mexico 605; United States 39; West Germany 30.
Metal including alloys, all forms	r 27,288	16,708	9,199	Mexico 11,660; Canada 2,985; Peru 1,048.
Magnesium metal including alloys, all forms	12,003	10,630	10,356	Norway 5,600; United States 508.
Manganese:				
Ore and concentrate	12,205	17,682	19,871	Gabon 14,012; Mexico 1,471.
Oxides	1,542	101	108	France 85; United States 10.
Metal	332	338	510	Republic of South Africa 192; Japan 82.
Mercury 76-pound flasks	r 4,910	5,308	5,729	Mainly from Mexico.
Molybdenum:				
Ore and concentrate	1,401	1,063	1,413	United States 642; Chile 272; Canada 149.
Metal including alloys, all forms	38	20	33	United States 10; West Germany 3; Netherlands 3.
Nickel:				
Matte, speiss, similar materials	--	(3)	--	All from West Germany.
Metal including alloys:				
Scrap	10	--	--	
Unwrought	3,209	1,500	NA	United States 746; Finland 165; West Germany 136.
Semimanufactures	1,782	923	1,068	Sweden 412; United States 132.
Platinum-group metals including alloys, all forms:				
Platinum troy ounces	6,366	6,687	3,408	West Germany 3,537; United States 1,222.
Other, including platinum alloys thousand troy ounces	34	32	NA	West Germany 21; Netherlands 5.
Rare-earth metals	2 2	--	--	
Selenium, elemental	2 14	13	NA	United States 4; West Germany 2.
Silicon metal	2 4,158	2,291	NA	Norway 917; United States 315; France 274.
Silver metal including alloys thousand troy ounces	3,764	2,480	3,687	West Germany 965; United States 792.

See footnotes at end of table.

Table 3.—Brazil: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [1]	Principal sources, 1975
METALS—Continued				
Sodium metal	30	37	NA	Mainly from West Germany.
Tellurium, elemental ——kilograms	[2] 627	11	NA	Do.
Tin:				
Ore and concentrate	6,015	3,137	1,493	Bolivia 2,502; Belgium-Luxembourg 243.
Oxides	160	122	141	West Germany 67; United Kingdom 46.
Metal including alloys, all forms	10	34	10	Panama 20; United States 8.
Titanium:				
Ore and concentrate:				
Ilmenite	35,880	15,233	41,250	Mainly from Australia.
Rutile	3,213	3,216	4,620	Netherlands 1,579; Australia 1,046.
Oxides	3,299	1,300	4,368	West Germany 634; France 320.
Metal including alloys, all forms	41	56	156	Italy 24; United States 24.
Tungsten metal including alloys, all forms	33	21	25	Portugal 6; United States 6.
Uranium and thorium oxides, including rare-earth oxides	162	133	NA	Mainly from United States.
Vanadium:				
Oxides	560	330	NA	Republic of South Africa 279; West Germany 28.
Metal including alloys, all forms	26	8	NA	Mainly from United States.
Zinc:				
Ore and concentrate	24,237	24,836	--	Canada 20,032; United States 4,804.
Oxides	192	98	121	West Germany 67; United States 30.
Metal including alloys:				
Unwrought	63,468	50,332	54,173	Peru 14,636; Mexico 13,647; United States 5,636.
Semimanufactures	267	312	20	Norway 74; United States 63.
Zirconium and hafnium:				
Ore and concentrate	7,891	6,903	10,864	Australia 4,865; United States 1,892.
Metal including alloys, all forms	1	[3]	--	Mainly from West Germany.
Other:				
Ash and residue containing nonferrous metals	2,022	2,241	NA	United States 1,895; Nigeria 150.
Oxides, hydroxides, peroxides of metals, n.e.s	1,793	1,631	NA	West Germany 638; United States 554.
Waste and sweepings of precious metals ——kilograms	26	22	NA	West Germany 12; Italy 9.
Metals including alloys, all forms:				
Alkali and alkaline-earth metals, n.e.s ——do	7	1	NA	Mainly from France.
Pyrophoric alloys	6	6	NA	Do.
Base metals including alloys, all forms, n.e.s	[r] 3	2	NA	West Germany 1; United States 1.
NONMETALS				
Abrasives, natural, n.e.s.:				
Pumice, emery, natural corundum, etc	1,157	999	626	United States 482; Italy 454.
Dust and powder of precious and semiprecious stones ——kilograms	196	207	3	United States 82; Ireland 59; West Germany 32.
Grinding and polishing wheels and stones	801	888	NA	West Germany 280; United States 244.

See footnotes at end of table.

Table 3.—Brazil: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [1]	Principal sources, 1975
NONMETALS—Continued				
Asbestos	38,621	29,800	33,881	Canada 13,063; Republic of South Africa 12,070.
Barite and witherite	129	221	251	United States 121; West Germany 50; United Kingdom 50.
Boron materials:				
Crude natural borates	18,138	8,628	NA	Netherlands 4,320; Argentina 4,048.
Oxide and acid	2,779	3,428	NA	United States 2,864; West Germany 168.
Bromine	35	87	NA	Israel 57; United States 29.
Cement	243,439	234,902	317,509	Uruguay 162,518; West Germany 28,726.
Chalk	3,014	1,609	NA	France 1,171; Belgium-Luxembourg 200.
Clays and clay products (including all refractory brick):				
Crude clays, n.e.s.:				
Bentonite	17,685	13,099	13,984	United States 9,150; Argentina 3,910.
Kaolin	20,514	4,889	14,812	Mainly from United States.
Andalusite, kyanite, sillimanite	r 100	246	244	France 200; United States 27.
Other	2,438	3,666	2,514	United States 1,848; Japan 1,217; United Kingdom 601.
Products:				
Refractory (including nonclay bricks)	68,553	33,364	NA	United States 12,693; Japan 8,466; West Germany 7,017.
Nonrefractory	2,616	1,483	NA	Italy 485; United States 410; Spain 318.
Cryolite and chiolite	2,190	2,498	2,201	Mainly from Denmark.
Diamond (excluding dust):				
Gem, not set or strung ——value	$1,473,765	$2,924,801	$1,210,030	United Kingdom $1,819,435; Belgium-Luxembourg $761,187.
Industrial ——carats	375,000	350,000	195,000	West Germany 125,000; United States 95,000.
Diatomite and other infusorial earth	1,578	1,914	1,554	United States 1,117; Mexico 416; West Germany 228.
Feldspar	32	1	2	Mainly from Switzerland.
Fertilizer materials:				
Crude:				
Nitrogenous	26,839	19,020	NA	All from Chile.
Phosphatic	1,310,537	887,175	1,417,660	United States 521,491; Morocco 286,124.
Manufactured:				
Nitrogenous	876,396	613,326	912,970	United States 301,793; West Germany 96,577; Netherlands 87,852.
Phosphatic:				
Thomas slag	51,555	18,165	NA	Belgium-Luxembourg 8,219; West Germany 4,996.
Other	751,410	517,629	NA	United States 353,659; Spain 59,391; Portugal 43,242.
Potassic	1,031,441	931,488	1,185,183	United States 436,003; Canada 241,790; East Germany 101,150.
Other, including mixed	457,129	487,314	NA	Mainly from United States.
Ammonia	91,794	77,769	NA	United States 36,574; Venezuela 21,895; Kuwait 10,292.
Fluorspar	62	--	--	
Graphite, natural	182	142	108	United Kingdom 55; Madagascar 51; West Germany 24.

See footnotes at end of table.

Table 3.—Brazil: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [1]	Principal sources, 1975
NONMETALS—Continued				
Gypsum and plasters	4,133	625	95	Bolivia 385; United Kingdom 153; West Germany 87.
Iodine	84	--	NA	
Lime	203	40	77	Mainly from Venezuela.
Lithium minerals	68	25	52	All from Argentina.
Magnesite	18	160	94	United Kingdom 100; Italy 37.
Mica:				
Crude, including splittings and waste	8	2	23	United States 1.
Worked, including agglomerated splittings	45	66	135	United States 32; France 19; Switzerland 15.
Pigments, mineral, including processed iron oxides	2,776	2,011	NA	West Germany 1,576; Spain 289.
Precious and semiprecious stones, except diamond [4] ---kilograms--	r 928	1,259	7,244	West Germany 432; Japan 403.
Pyrite, gross weight	277	120	214	West Germany 100; United States 20.
Salt and brine	126	143	5	Bolivia 124; United Kingdom 18.
Sodium and potassium compounds, n.e.s.:				
Caustic soda	326,768	267,011	306,523	United States 184,565; France 30,371.
Caustic potash, sodic and potassic peroxides	3,697	2,084	NA	France 990; United States 301; West Germany 267.
Sodium carbonate (soda ash)	44,916	63,001	70,809	Romania 16,000; Japan 13,750; East Germany 7,603.
Sodium sulfate	63,809	95,596	96,397	Mainly from Mexico.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked:				
Calcareous	3,032	453	1,032	Italy 175; Uruguay 102; Portugal 100.
Other	24	65	119	Uruguay 51; Italy 14.
Worked	233	44	123	Mainly from Italy.
Dolomite, chiefly refractory grade	2,640	1,770	2,189	Do.
Gravel and crushed rock	211	510	--	Mainly from France.
Limestone (except dimension)	85	(3)	--	Mainly from Paraguay.
Quartz and quartzite	491	273	12	Switzerland 100; West Germany 97; Belgium-Luxembourg 52.
Other	302	324	856	Mainly from United States.
Sulfur:				
Elemental:				
Other than colloidal	611,128	410,227	597,036	United States 209,360; Canada 108,862.
Colloidal	217	202	222	Mainly from United States.
Sulfur dioxide	160	4	2	West Germany 2; United States 2.
Sulfuric acid, oleum	111,863	67,016	84,453	Norway 25,795; United States 24,229.
Talc, steatite, soapstone, pyrophyllite	132	79	173	United States 64; Norway 15.
Other:				
Crude:				
Meerschaum	--	(3)	NA	All from Italy.
Other	148	358	NA	United States 237; Argentina 120.
Slag, dross, and similar waste, not metal bearing	472	--	NA	
Oxides and hydroxides of magnesium, strontium, barium	1,335	1,743	NA	Japan 1,116; United States 348.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	34	317	NA	United Kingdom 297; Spain 20.

See footnotes at end of table.

Table 3.—Brazil: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976[1]	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural	938	709	NA	United States 666; Argentina 40.
Carbon black	23,478	6,531	NA	West Germany 2,946; Argentina 1,450; United States 856.
Coal, all grades, including briquets thousand tons	1,602	2,762	3,232	United States 1,818; Poland 788; Australia 122.
Coke and semicoke	211,000	170,211	130,649	West Germany 106,976; Belgium-Luxembourg 17,195.
Hydrogen and rare gases	12	6	NA	United States 4; United Kingdom 1.
Peat, including peat briquets and litter	12	5	9	All from West Germany.
Petroleum:				
Crude thousand 42-gallon barrels	r 240,661	253,323	293,295	Saudi Arabia 89,283; Iraq 74,344; Kuwait 27,534.
Refinery products:				
Gasoline do	4,190	790	618	Netherlands Antilles 637; Israel 152.
Kerosine do	--	25	(3)	All from United States.
Distillate fuel oil do	328	408	1,933	Venezuela 336; Argentina 72.
Residual fuel oil do	140	164	--	All from Venezuela.
Lubricants (including grease) do	3,368	2,061	1,197	United States 1,243; Netherlands Antilles 290.
Other:				
Liquefied petroleum gas do	2,387	328	NA	Saudi Arabia 198; Venezuela 130.
Naphtha do	8,753	7,363	NA	Saudi Arabia 3,788; Kuwait 2,760.
Mineral jelly and wax do	162	87	NA	Singapore 40; East Germany 24.
Bitumen and other residues and bituminous mixtures, n.e.s do	28	9	NA	United States 4; United Kingdom 2.
Pitch, pitch coke, petroleum coke do	466	299	NA	Mainly from United States.
Unspecified do	127	132	1,147	NA.
Total do	19,949	11,666	4,895	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	171,632	129,335	NA	United States 57,384; Venezuela 56,974.

r Revised. NA Not available.
[1] DNPM. Anuario Mineral Brasileiro—1977. 282 pp.
[2] Revised from none.
[3] Less than ½ unit.
[4] Partial figures; quantities reported are valued at r $477,940 in 1974 and $585,148 in 1975, which exclude unspecified quantities valued at $53,690 in 1974 and $247,790 in 1975.

COMMODITY REVIEW

METALS

During 1976, the Conselho Nacional de Não-Ferrosos e Siderúrgia (CONSIDER) approved seven projects in the nonferrous industry, four of which involve expansion of currently operating plants as shown in table 4. Total investment required was estimated at over $1 billion. The Brazilian "content index" relating to local procurement for these projects was set at 72%. The primary capacity and demand projected to 1980 by CONSIDER for the nonferrous metals group are given in table 5.

Table 4.—Brazil: Nonferrous projects approved by CONSIDER in 1976

Company	Location	Capacity (thousand metric tons per year)		Scheduled startup date	Estimated cost (millions)
		Current	New or expanded		
Aluminum:					
Valesul Alumínio S/A	Rio de Janeiro	--	80	1979	$248
Cia. Mineira de Alumínio (Alcominas)	Poços de Caldas, Minas Gerais	60	90	1980	80
Alcan Alumínio do Brasil S/A (Albras)	Ouro Prêto, Minas Gerais	33	60	1979	70
Copper: Caraíba Metais S/A	Aratu, Bahia	--	100	1979	528
Lead:					
Plumbum S/A	Adrianópolis, Paraná	15	48	1982	17
Cia. Brasileira de Chumbo (COBRAC)	Santo Amaro, Bahia	32	45	1980	17
Zinc: Mineração Morro-Agudo S/A	Paracatu, Minas Gerais	--	35	1979	79

Table 5.—Brazil: Nonferrous metals, 1976 and projected 1980

(Metric tons)

Commodity	1976			1980		
	Primary production	Primary demand		Primary capacity	Primary demand	Percent of self-sufficiency
		Apparent	Percent change from 1975			
Aluminum	139,175	218,000	+10	365,000	440,000	83
Copper	--	148,000	+22	100,000	333,000	30
Lead	43,672	53,000	+8	71,000	134,000	53
Nickel	[1] 2,149	4,100	+8	8,200	11,000	75
Tin	6,600	4,500	+45	16,000	6,400	250
Zinc	43,154	95,000	+15	125,000	145,000	86

[1] Nickel content of ferronickel.

Source: Ministry of Industry and Commerce. CONSIDER Annual Report 1976, p. 23.

Aluminum.—The Mineração Rio do Norte S/A, a consortium led by Cia. Vale do Rio Doce (CVRD), continued construction of the port facility and other infrastructure for the Trombetas project just north of the Amazon River. Initial shipments of bauxite were scheduled for 1979 and an output level of 3.3 million tons per year was expected by 1982. During the year, Rio Tinto-Zinc Corp. Ltd. dropped out of the Trombetas project.

A Japanese-Brazilian agreement was reached in 1976 to proceed with the aluminum smelter project of Albras, a joint venture of CVRD and the Light Metal Smelter Association of Japan. The scaled-down 320,000-ton-per-year smelter and associated alumina facility were estimated to cost $940 million and $400 million, respectively. Initial alumina production was scheduled for the early 1980's, with a significant part of the output destined for export to Japan.

During the year, an estimated 100-million-ton bauxite deposit containing 40% alumina was discovered near the Carajás iron ore reserve in Pará State. CVRD geologists announced the discovery of a 200-million-ton bauxite deposit in Paragominas, Pará.

The Companhia Brasileira de Alumínio (CBA) announced plans to double its current 40,000-ton-per-year aluminum capacity to 80,000 tons per year by 1978 at a cost of $120 million. Further expansion to 120,000 tons per year was projected by 1982. The Aluminum Co. of Canada Ltd.'s (Alcan) Pindamonhangaba smelter near São Paulo was being expanded from a capacity of 25,000 tons to 50,000 tons per year by 1981.

The 15% increase in the production of primary aluminum in 1976 reflected the increased capacity of Alcominas from 30,000 tons to 60,000 tons per year.

Beryllium.—DNPM reported a 450% increase in measured reserves of beryl, primarily in the municipalities of Salinópolis and San Jose da Safira in the State of Minas Gerais.

Chromium.—Mine production of chromite increased 26% to a record level of 887,000 tons of crude ore, compared with an output of 24,000 tons a decade ago. Beneficiated output, however, declined 14%. In 1976 Brazil exported 47,460 tons of ferrochromium (valued at $20 million f.o.b.), an increase of 38% in tonnage. Brazil's major chromite producer, Companhia de Ferro-Ligas da Bahia S/A (FERBASA), produced 60,000 tons of high-carbon ferrochrome and 6,000 tons of the low-carbon alloy in 1976.

A joint venture of FERBASA and Japanese interests, Companhia de Mineração Serra da Jacobina (SERJANA), was set up to increase production of concentrate an additional 150,000 tons per year over a 10-year period.

During 1976, measured reserves of chromite increased 26% to 6.6 million tons located mostly at Campo Formoso in the State of Bahia. DNPM reported the total of measured, indicated, and inferred chromite ore reserves at 23 million tons. Prospecting activities were centered in Bahia. A West German firm, Kloeckner Und Co., set up a joint venture with FERBASA, called Ferklock, to explore and exploit FERBASA's chrome deposits in Bahia.

Columbium.—Pyrochlore ore production increased 30%, but was below the record high of 1973. Exports of ferrocolumbium in 1976 increased sharply 121% to 9,155 tons. Valued at $47.4 million, they represented 61% of all ferroalloys exported by Brazil in 1976. The United Kingdom and France were the major markets.

The major producer of pyrochlore concentrate and ferrocolumbium, Companhia Brasileira de Metalurgia e Mineração (CBMM), was planning expansion from 36,000 tons to 48,000 tons per year of pyrochlore concentrate and from 12,000 tons to 24,000 tons per year of ferrocolumbium by 1980. Mineração Catalão de Gerais S/A, an affiliated company of Brasimet Comercio e Industria S/A (BRASIMET), located in Minas Gerais State, started operations in 1976 and expected to be at full capacity of 4,000 tons per year of concentrate by 1977.

Copper.—Mine production of copper ore declined sharply, continuing the strong downward trend since the peak year of 1971 when 504,000 tons of copper ore and 5,100 tons of primary copper were produced. Brazil continued to be heavily dependent on imports of primary copper.

Caraíba Metais S/A, a subsidiary of Insumos Basicos S/A-Financiamento e Participações (FIBASE), was negotiating a loan from the Inter-American Development Bank for partial financing of the Caraíba

complex in northeastern Bahia. Besides the copper smelter that was under construction, the project included investments in open pit and underground mine facilities scheduled to produce 100,000 tons per year of concentrates by the early 1980's. The smelter located at Camaçari, Bahia, would also be supplied from the existing Camaquã mine in Rio Grande do Sul and the Pedra Verde mine in Ceará.

Exploration for copper was intense in 1976. CPRM as well as private companies focused significant efforts on the States of Bahia, Ceará, and Rio Grande do Sul. New discoveries, especially in the Curaçá Valley (400 kilometers northeast of Salvador, Bahia) and Rio Grande do Sul, elevated Brazil's total reserves of copper ore to 134 million tons with an average grade of 1.23%.

Iron Ore.—In 1976 Brazil was the world's third largest producer and the second largest exporter of iron ore. Brazil accounted for 10% of world output of iron ore. Although production of run-of-mine ore decreased slightly in 1976, output of beneficiated ore increased 4%. The impressive growth over the past decade in the production and export of iron ore by Brazil is shown in table 6. In 1976 Japan with 29% was the major market for Brazilian iron ore exports, followed by West Germany (18%) and the United States (11%). Internal consumption reached 12.7 million tons, a 16% increase over the 1975 figure.

Brazil's production of ore pellets from the two plants operated by CVRD at Tubarão achieved a record high of 4.6 million tons, a 7% increase over the 4.3 million tons produced in 1975.

There were 139 large and small iron ore producers, of which 29 had production exceeding 100,000 tons in 1976. The "Iron Quadrangle" in the State of Minas Gerais with 75% of the measured reserves continued as the only significant area of production. Table 7 shows nine major producers, which together accounted for 96% of Brazil's production.

Table 6.—Brazil: Production and exports of iron ore

Year	Production [1] (thousand metric tons)	Exports			
		Quantity (thousand metric tons)	Percent change from previous year	Value (thousands)	Average export price (per metric ton)
1967	r 21,723	14,279	+11	$102,783	$ 7.20
1968	r 24,532	15,050	+5	104,450	6.94
1969	r 27,571	21,478	+43	147,400	6.86
1970	r 36,381	27,943	+30	209,600	7.50
1971	37,486	31,020	+11	237,000	7.64
1972	46,471	30,512	−2	231,708	7.59
1973	r 55,019	44,963	+47	362,811	8.07
1974	76,071	59,439	+32	571,159	9.61
1975	89,894	72,522	+22	920,891	12.70
1976	[2] 94,087	67,138	−7	995,473	14.83

r Revised.
[1] Data for years prior to 1972 cover crude or run-of-mine ore; those for 1972 and subsequent years cover beneficiated ore plus ores of direct-shipping grade.
[2] Output of beneficiated ore was 92,610,645 tons.

Table 7.—Brazil: Major producers and exporters of iron ore
(Million metric tons)

Company	Mine production		Exports	
	1975	1976	1975	1976
CVRD	52.2	49.9	47.3	[1] 47.3
Mineraçoes Brasileiras Reunidas S/A (MBR)	10.6	11.3	--	11.0
S/A Mineração da Trindade (SAMITRI)	8.1	9.1	--	[2] 6.9
Cia. de Mineração de Ferro e Carvão (FERTECO)[3]	4.1	4.5	--	3.7
Cia. de Aços Especiais Itabira (ACESITA)	NA	4.4	--	([4])
Companhia Siderúrgica Nacional (CSN)	--	3.2	--	--
Itaminas Comercio de Mineração S/A (ITAMINAS)	.8	.8	--	--
Other	14.1	10.9	25.2	1.8
Total	89.9	94.1	72.5	67.1

NA Not available.
[1] Total exports by CVRD of 54 million tons include 6.7 million tons exported for the account of other producers.
[2] Includes 3.5 million tons shipped by CVRD which is not added into total.
[3] Includes output of Cia. de Mineração Serra da Moeda.
[4] ACESITA produces for its own use as steelmaker.

CVRD maintained its position as the world's largest producer and exporter of iron ore. By yearend CVRD held firm long term contracts for the delivery of iron ore totaling 727 million tons.[3] CVRD acquired a controlling interest in Minas d'El Rey Don Pedro S/A, thus increasing the company's reserves in Minas Gerais. Together with Kawasaki Steel Corporation, CVRD established Minas da Serra Geral S/A to exploit an iron ore deposit at Capanema, Minas Gerais. The $150 million mine project is designed to produce 11 million tons beginning in late 1981.

The Itavale project, a joint effort of CVRD and ACESITA to mine 7 million tons per year from the Periquito mine in the Iron Quadrangle, entered into operations during the year. The measured ore reserves at the Periquito mine included 170 million tons of hematite averaging 67% iron and 200 million tons of itabirite averaging 50% iron. Indicated and inferred reserves of hematite and itabirite amounted to 700 million tons. At Caué, CVRD's largest mine, ore reserves totaled 1,116 million tons including 385 million tons of hematite grading over 64% iron and 731 million tons of itabirite grading 45% to 50% iron. The large Serra dos Carajás project in Pará State, a joint venture with the United States Steel Corporation, remained undefined at yearend.

At yearend, CVRD was preparing the inauguration of the Cia. Italo-Brasileira de Pelotização (ITABRASCO) pellet plant at the Tubarão complex designed primarily for exports to European markets. This joint venture with the Italian Società Finanziaria Siderurgica S.p.A. (Finsider) group was expected to produce 3 million tons of pellets in 1977.

Additional CVRD pelletization plants at Tubarão included that of Cia. Nipo-Brasileira de Pelotização (NIBRASCO), with Japanese interests, for 6 million tons per year and that of Cia. Hispano-Brasileira de Pelotização (HISPANOBRAS), with a Spanish group, for 3 million tons per year. Construction of civil works of the HISPANOBRAS plant, scheduled to begin operations in mid-1978, began in August 1976.

In 1978, CVRD was expected to reach a production of 60 million tons of iron ore including 6 million tons of pellets. By 1981 CVRD's annual capacity was expected to exceed 100 million tons including 25 million tons of pellets.

New capacity and expansion of current capacity actively underway during the year are summarized in table 8.

[3] CVRD Annual Report 1976, p. 2.

Table 8.—Brazil: Iron ore projects underway in 1976

Company	Mine	Capacity (million metric tons per year)		Startup date	Cost (millions)
		Current	New or expanded		
CVRD	Conceição, Dois Córregos.	14.0	24.7	1978	[1] $220
MBR	Águas Claras	11.5	15.0	1977	NA
FERTECO	Fábrica [2]	3.5	5.0	1977	130
SAMARCO Mineração S/A.	Germano [3]	--	7.0	1977	564

NA Not available.
[1] Covers only the ore-processing complex at Conceição.
[2] An additional 2.5-million-ton-per-year pellet plant was to come onstream in 1977 at Fábrica.
[3] A 5-million-ton-per-year pellet plant was under construction at Pôrto Ubu, Espírito Santo.

Iron and Steel.—The production of crude steel increased 10.4%, continuing the strong uninterrupted upward trend of the past decade. This rise compares favorably with the 5% growth in world steel output. Imports of steel products decreased significantly to less than half those of 1975. Steel exports valued at $91 million went chiefly to Nigeria (30%) and the United States (23%). Brazil's demand for steel projected for 1980 ranges from 17 million to 19 million tons and for 1985, from 32 million to 38 million tons.

Brazil's steel industry in 1976 experienced many uncertainties. Financing was deemed inadequate to support the country's ambitious steel expansion programs, especially those of the Government-owned producers, whose budgets were under restraint to control inflation. Construction work in the transportation program Ferrovia do Aço (Railway of Steel), designed to double Brazil's iron and steel rail-carrying capacity, was seriously retarded during the year. In addition, Government and private steel manufacturers felt that domestic steel prices were low considering the high and increasing costs of imported raw materials.

Table 9 provides a summary of the most important projects with new or expanded steel production facilities. By yearend, stage II of the master plan for expansion of the major Government-owned producers CSN, Usinas Siderúrgicas de Minas Gerais (USIMINAS), and Companhia Siderúrgica Paulista (COSIPA) was nearing completion. Of special note within stage II were the commissioning of the blast furnaces of CSN and COSIPA and the continuous-casting plant of USIMINAS. Steel output by USIMINAS in 1976 of 2.3 million tons was 33% above the 1975 output. COSIPA encountered major difficulties with its stage II expansion. COSIPA's significant drop in production was owing in part to a major accident and fire. As for stage III of the master plan, procurement of equipment underway in 1976 was expected to be completed in 1977.

The Itaqui steel project, a joint Brazil-Japan steel plant to be located at the port of Itaqui in Maranhão State, was shelved early in 1976 at Japanese request, owing to unfavorable world market conditions.

CONSIDER completed the main studies which make up Brazil's steel master plan. On the basis of these studies, CONSIDER approved resolutions to support steel-making based on scrap and wood charcoal, aimed at decreasing Brazilian dependence on foreign reductants.

Table 9.—Brazil: Active steel projects, 1976

Company or project	Production (metric tons)	New or expanded capacity (million metric tons)	Startup date	Observations
CSN	1,366,200	4.5	NA	Stage II was under construction for 2.5 million tons.
USIMINAS	2,345,300	3.5	1979	A new plate mill is to be ready in 1977.
COSIPA	788,700	3.5	delayed	Stage II output of 2.3 million tons is planned for 1977.
Cia. Siderúrgica da Guanabara (COSIGUA).	341,300	.5	NA	The Purofer direct-reduction plant is scheduled for 1977.
Tubarão steel project (Siderúrgica Brasileira S/A (SIDERBRAS), CVRD, Finsider, Kawasaki).	--	3.0	1982 (stage I)	In 1976, SIDERBRAS signed agreements with Finsider and Kawasaki for this joint venture.

NA Not available.

Lead.—The 12% increase in primary and secondary metallic lead output was a result of more efficient use of installed smelter capacities and improved technology. Output of primary lead increased 16%. Mine production of lead ore continued its downward trend after the peak output of 1972 when 374,200 tons of lead ore was produced. Imports of lead concentrate, primary lead, and lead products also continued a downward trend. Imports of lead concentrate in 1976 were mostly from Canada (54%) and the United States (46%). Refined lead imports were from Mexico (50%) and Peru (34%). Prospecting efforts for lead in 1976 were centered in northern Brazil.

Manganese.—Despite an increase in mine production of manganese ore to a new high of 2,881,000 tons for the recent decade, the output of beneficiated ore decreased 21%. Tonnage of ore exports declined 31% while the f.o.b. export value declined 18% to $66 million. Apparent domestic consumption was 400,000 tons.

Industria e Comercio de Minerios S/A (ICOMI) continued as the major producer and exporter of manganese ore from the Amapá Territory. ICOMI is jointly owned by Cia. Auxiliar de Empresas de Mineração (CAEMI) (51%) and Bethlehem Steel Corporation (49%). The ore and pellets are shipped out of the port of Santana on the northern bank of the Amazon River delta a few miles west of the small town of Macapá, Amapá Territory. The pellet plant has enabled the utilization of previously unsold fines and low-grade ores. ICOMI's pellet capacity was 212,000 tons per year. ICOMI shipped 1,047,000 tons of ore in 1976 including 149,300 tons of pellets, compared with 1,254,055 tons including 100,500 tons of pellets in 1975. The 1976 shipments went to the United States and 15 other countries. Domestic sales in 1976 were about 120,000 tons.

In 1976, the Urucum deposits near Corumbá, Mato Grosso State, were a small but growing source of manganese ore as indicated in the following tabulation, in thousand metric tons:

State or Territory	Production		Measured ore reserves	Average grade (percent)
	1975	1976		
Amapá	1,671	1,218	25,270	38
Minas Gerais	335	334	7,550	32
Bahia	101	67	2,410	32
Mato Grosso	1	46	14,700	45
Goiás	47	30	560	45
Espírito Santo	1	1	NA	NA
Total[1]	2,156	1,696	50,500	39

NA Not available.
[1] Data may not add to totals shown because of independent rounding.

Urucum Mineração S/A, formed in April by a Brazilian group, produced 36,000 tons of ore grading 46% manganese from its mines in Urucum. The new company was organized by CVRD, the State-owned Cia. Matogrossense de Mineração (METAMAT), and the privately-owned Cia. Vale do Paraupeba (Alcindo Vieira group), each with one-third interest. The ore was previously mined by SOBRAMIL, a subsidiary of the Brazilian-owned Chamma group, in association with Companhia Meridional de Mineração (MERIDIONAL) of United States Steel interests, but there has been no mining since 1972. Before the deposits can be fully developed, problems of transportation and high alkali and phosphorus content must be overcome. Output was expected to be for both domestic consumption and export, with mining to start before yearend.

MERIDIONAL produced 220,000 tons of 39% manganese ore at its Morro da Mina mine at Lafaiete, Minas Gerais. The output from Minas Gerais was primarily for the domestic steel industry. Five companies in Brazil produced 98,738 tons of low- and high-carbon ferromanganese in 1976.

Cia. Paulista de Ferro-Ligas, a ferroalloy producer headquartered in São Paulo, was readying a new plant at Corumbá for production of ferromanganese from Urucum ore by mid-1977. The plant will use two 4-megavolt-ampere furnaces in a two-step process expected to solve the high-phosphorus, high-alkali problem, while producing 24,000 tons per year of high-carbon ferromanganese and silicomanganese. Approximately one-half of the production will be for export. Company plans also include two similar furnaces to begin producing ferromanganese and silicomanganese at Macapá, Amapá, by yearend 1977. The annual capacity of this plant would also be 24,000 tons.

In June, Construtora Alcindo Vieira CONVAP S/A (CONVAP), a Brazilian contracting company, together with METAMAT formed a new company, Cia. Matogrossense de Ferro-Ligas (FERMAT), with plans to install five 20-megavolt-ampere furnaces by 1982 in a new plant at Três Lagoas, near the Jupiá hydroelectric plant northwest of São Paulo at the eastern boundary of the State of Mato Grosso. Plans called for the first two furnaces to begin production of high-carbon ferromanganese and silicomanganese from Urucum ore in 1981, half for domestic consumption and half for export. Research was conducted in 1976 on the best metallurgy to use on the iron-rich, high-alkali Urucum ore.

Nickel.—In 1976 there was a large increase in the mine output of lateritic nickel ore. The average grade mined was 1.25% nickel. The 6% decrease in the nickel content of ferronickel produced resulted from the closing of Cia. de Niquel do Brasil and the decrease in the grade of ore mined by the major producer in Minas Gerais, Morro do Niquel S/A-Mineração, Industria e Comercio, a subsidiary of BRASIMET. Brazil produced no primary refined nickel. Construction was underway on a project of Companhia Niquel Tocantins (CNT) of the Votorantim group in Niquelândia, Goiás, where estimated reserves of 340,000 tons of contained nickel in 20 million tons of ore will be used to produce 5,000 tons per year of electrolytic nickel by 1978.

Baminco Mineração e Siderúrgia S/A, a subsidiary of International Nickel Co. of Canada Ltd. (INCO), announced the discovery of promising nickel ore reserves in the São Félix do Xingu region of Pará State. CVRD prepared its mining plan with respect to its nickel discovery in São João do Piauí, Piauí State, Brazil's second-richest known nickel area after Goiás.

Tin.—DNPM reported a 45% increase in measured tin ore (cassiterite) reserves to 79,000 tons averaging 65% tin. The increases were primarily in the Pôrto Velho area of Rondônia.

Output of beneficiated tin ore increased 18% in 1976 to a record high level. In line with this increase, Brazil imported a reduced amount of tin concentrate, primarily from Bolivia, to feed the country's smelters. During the year, 33 companies in Brazil's National Tin Association severed relations with the Patiño-controlled Companhia Estanífera do Brasil (CESBRA) group to form a new tin association.

Titanium.—DNPM reported a 100% increase in measured reserves of titanium ore, which at the end of 1976 were as follows: Anatase, 57 million tons; ilmenite, 3.5 million tons; and rutile, 91,000 tons. Production of ilmenite concentrate increased sharply 218% but did not exceed

the peak output of 1970 when 20,644 tons of beneficiated ore was produced.

Tungsten.—Mineração Tungstenio do Brasil (MTB), a subsidiary of Union Carbide Corp., continued to develop new ore deposits near Currais Novos in Rio Grande do Norte. MTB expected to begin production in 1977 of up to 7,000 tons of ore per month to yield 500 tons of scheelite concentrate per year. Government sources indicated that the MTB output combined with increased production from the tungsten mines of BRASIMET, owned by private Brazilian interests and the Hochschild Group, would enable Brazil to increase its production 25% per year during the 1977–80 period.

During 1976, Government geologists working in northeastern Brazil located a minimum of 44,000 tons of economically recoverable tungsten metal in deposits ranging from 0.3% to 2.6% in grade. For 1976, DNPM reported a major increase in the measured reserves of tungsten to 4,708 tons of contained metal compared with 1,181 tons reported in 1975.

Zinc.—Brazil continued the strong upward trend in its production of primary zinc. The 37% increase in 1976 to 43,154 tons contrasts sharply to the 1,800 tons produced in 1967. Nonetheless, Brazil produced less than one-half of the apparent domestic consumption of 95,000 tons. The increase in output was attributed to Cia. Mineira de Metais (CMM), which was increasing installed capacity from 25,000 tons to 50,000 tons per year. In 1976, CMM began to produce special high grade zinc totaling 3,400 tons with a rated capacity of 10,000 tons expected to be ready in 1977.

Zirconium.—Production of zirconium concentrate continued to be less than the peak output of 1971 of 4,240 tons (revised). DNPM reported a 430% increase in measured reserves of zirconium ore to 815,000 tons in the new area of Mataraca, Paraíba State, and São João da Barra in Rio de Janeiro State.

NONMETALS

As a result of stepped-up activity in exploration by CPRM and mining companies, DNPM reported substantial increases in the measured reserves of several nonmetallic ores: Barite (2,300%), coal (90%), diamond (37%), feldspar (28%), graphite (108%), lithium (33%), mica (95%), quartz (214%), slate (6,700%), and vermiculite (198%). The extent of a large deposit of carnallite for potassic fertilizers in Brazil's Northeast region was announced in 1976.

Fertilizer Materials.—Brazil continued to depend heavily on imports to meet its demand for fertilizer materials. In 1976, 4.04 million tons (a 38% increase) of phosphatic, nitrogenous, and potassic fertilizer materials was imported at a cost of $268 million. Brazil's output of these materials amounted to 1.49 million tons. Output of natural phosphates (P_2O_5 content) increased 136%, manufactured phosphates 58%, and nitrogenous fertilizers 14%. During 1976, internal fertilizer prices were below world prices and in December a 40% price subsidy was removed, causing a 53% increase in average prices. DNPM specified for the first time the reserves of potassic fertilizer ore in the State of Sergipe in the localities of Capela-Siriri, Japaratuba-Pirambú, and Pirambú-Carmópolis. Measured reserves of carnallite were stated at 2.0 billion tons averaging about 10% potash, indicated reserves at 3.5 billion tons, and inferred reserves at 1.4 billion tons.[4] Late in 1976, the Brazilian Government indicated its plans to create another subsidiary of PETROBRAS, Petrobras Mineração S/A, to exploit the potash deposits in Sergipe.

As shown in table 10, several projects were under construction or being planned to exploit Brazil's abundant phosphate resources. Brazil's measured ore reserves were estimated at 1.1 billion tons. Brazil was expected to meet its requirements for phosphate rock entirely from domestic sources by the mid-1980's.

Petrobras Fertilizantes S/A (Fertibras), established by PETROBRAS in March, finalized plans to produce nitrogenous fertilizers in a plant to be located in Rio Grande do Sul. Output of ammonia and urea were projected at 1,200 tons and 800 tons per day, respectively, by 1980. Production of nitrogenous fertilizer products in Brazil was chiefly under the control of subsidiaries of PETROBRAS.

Quartz Crystal.—Brazil, which has 95% of the world's known reserves of natural

[4] DNPM. Anuario Mineral Brasileiro—1977. Pp. 17 and 182.

Table 10.—Brazil: Phosphate projects

Company and ownership	Location	Measured reserves (million metric tons)	Planned capacity of P_2O_5 concentrate (thousand metric tons per year)	Projected startup date
Araxá S/A Fertilizantes e Produtos Quimicos (ARAFERTIL).[1]	Araxá, Minas Gerais	273	600	1977
Metais de Goiás S/A (METAGO)	Catalão, Goiás	147	570	NA
Fosfatos de Goiás S/A (FOSFAGO)	----do	73	500	1978
Fertilizantes Vale do Rio Grande S/A (VALEFERTIL), CVRD.	Uberaba, Minas Gerais	NA	(2)	1979
Mineração Vale do Paranaiba S/A (VALEP) CRVD.	Tapira, Minas Gerais	318	900	1978
Serrana S/A de Mineração, Santista Group and Bunge y Born Ltda. S/A.	Sorocaba, São Paulo	60	330	1980
Fertilizantes Fosfatados S/A (FOSFERTIL).[3]	Patos de Minas, Minas Gerais.	256	1,000	1981
Total		1,127	3,900	

NA Not available.
[1] Owned 40% by Serrana S/A de Mineração, 40% by the Itaú group, and 20% by FIBASE.
[2] CVRD's fertilizer complex will produce per year: 330,000 tons of monoammonium phosphate, 340,000 tons of triple superphosphate, and 560,000 tons of phosphoric acid.
[3] Equity composition established in 1976: Cia. Agricola de Minas Gerais S/A (CAMIG) 20%, Fertibras 20%, FIBASE 20%, and private capital 40%.

quartz crystal, produced an estimated 1 ton of electronic-grade quartz crystal, 1,964 tons of lower-grade crystal-lasca (lump quartz, the feedstock for cultured quartz growth), and 73 tons of other grades. The total crystal export quota for 1976 was 3,000 tons. The 1,964 tons of exports of crude crystal and lasca in 1976 went primarily to the U.S.S.R. (51%), Japan (11%), and East Germany (10%).

XTAL do Brasil initiated experimental production of electronic-grade cultured quartz to compete directly in the world market and projected full-scale operation by early 1977.

MINERAL FUELS

In May, the Government established a requirement to prepare a National Energy Balance, an analysis of Brazil's energy sector, to be undertaken annually. The following percentage distribution of Brazil's sources of overall energy consumption for selected years shows Brazil's intention to decrease its dependence on petroleum in favor of other domestic energy alternatives:

Year	Petroleum, natural gas, alcohol[1]	Water power	Bagasse, firewood, charcoal	Coal	Uranium
1966	33.6	16.5	46.1	3.8	--
1970	38.5	18.9	38.7	3.9	--
1976	43.8	23.8	28.9	3.5	--
1980	43.4	27.6	23.3	4.8	0.9
1986	[2] 40.8	31.8	16.0	7.4	4.0

[1] Includes shale oil in 1986.
[2] The alcohol portion is 1.7%.

Source: Ministry of Mines and Energy. National Energy Balance—1977, Federative Republic of Brazil. Pp. 16–17.

Alcohol Energy.—The Federal Government was planning a significant expansion of alcohol production from sugarcane and manioc. In use as a fuel supplement since 1933, alcohol-gasoline mixtures represented about 3% of the gasoline sold in 1976. Brazil's goal was to produce enough alcohol so that all gasoline consumed in the early 1980's would consist of 20% alcohol and 80% petroleum. It was estimated that this mixture of alcohol and gasoline ultimately would cut Brazil's oil imports 10%. Re-

search programs designed to test the feasibility of all-alcohol automobile engines were underway. The 20–80 mixture would require Brazil to more than quadruple its alcohol production. This goal would also require a diversion of 2% of Brazil's 110 million acres of farmland to the production of sugarcane and manioc for industrial alcohol.

Coal.—Prospecting for coal was active during the year. As part of an intensive program, "Projeto Carvão," DNPM discovered 80 million tons of coking-grade coal at Gravataí and 300 million tons at Faxinal, both in Rio Grande do Sul. In Araranguá-Tôrres, Santa Catarina State, 59 million tons was discovered. The Ministry of Mines and Energy reported that at yearend Brazil's coal reserves increased to 20.1 billion tons, a 34% increase over 1975 reserves. Official estimates of metallurgical coal reserves totaling 3.6 billion tons were distributed as follows: Rio Grande do Sul, 2.8 billion tons; Santa Catarina, 760 million tons; and Paraná, 43 million tons.

Production of run-of-mine coal increased 10% in 1976 to 7 million tons, while the output of marketable coal increased 16% to 3.3 million tons. Washed metallurgical coal output from Santa Catarina, the major production area for this coal type, totaled 865,000 tons. Four projects under study at Metropolitana, Araranguá, Criciúma, and Prospera could increase the State's metallurgical coal output 600,000 tons per year. As shown in table 11, the balance of 2.4 million tons produced in 1976 was mostly steam coal. Two coal gasification projects were being planned in the States of Santa Catarina and Rio Grande do Sul. Steam coal was being stockpiled because a market did not exist to absorb the increased production.

Table 11.—Brazil: Coal production, by type

(Thousand metric tons)

Type of coal	State	1972	1973	1974	1975	1976
Metallurgical	Santa Catarina	809	785	1,071	804	865
Coke	do	20	28	46	45	72
Steam	do	612	636	970	878	1,232
Do	Paraná	200	190	190	166	182
Do	Rio Grande do Sul	876	638	915	785	826
Total steam		1,688	1,464	2,075	1,829	2,240
Reducing	Rio Grande do Sul	--	50	64	84	76
Grand total [1]		2,517	2,327	3,256	2,762	3,253

[1] Totals may differ from data given elsewhere in this chapter because of difference in source.

Source: Ministry of Mines and Energy. Relatorio de Atividades—1976, Federative Republic of Brazil. P. 79.

During the year, CONSIDER passed a resolution requiring Brazil's major State-owned steelmills to increase the use of domestic coking coal from 20% to 30% in their mix. The domestic coal in the mix in 1976 was actually 21.7%, compared with 25.7% in 1975. The shortfall was caused by the inability of the coal mining companies in Santa Catarina to meet production targets. Consumption of imported metallurgical coal by the steel industry reached 2,997,000 tons, a 35% increase over that of 1975, at a cost of $180 million. Consumption of charcoal by the steel industry was 3,287,000 tons. During 1976, SIDERBRAS, the Government steel holding company, was given the responsibility of coordinating and supervising all imports of coking coal. It was estimated that coking coal imports could reach 7 million tons by 1980 and 15 million tons by 1985. The projected demand for domestic metallurgical coal in 1985 is 4.6 million tons.

Brazil signed agreements with Colombia and Poland to diversify its sources of imported coal. The agreement signed with Colombia at midyear provided for a joint venture to locate and develop Colombian coal and for the shipment of up to 20 million tons to Brazil.

An agreement was concluded with Poland covering an exchange of 11.9 million tons of Brazilian iron ore for 14.8 million tons of Polish coal. The agreement also provided for Polish technical assistance in improving the quality of Brazilian coal. In

1976, Brazil imported 1,151,000 tons of coal from Poland.

Natural Gas.—The production of natural gas by PETROBRAS, the sole producer, reached a record high but was only slightly above that of 1975. Reserves of natural gas as of yearend 1976 increased 31% to 1.2 trillion cubic feet. The reserve increases were located in several fields on the Continental Shelf of the oil producing region of Brazil's northeast.

Nuclear Energy.—Brazil's rate of industrial growth indicates that by the year 2000 the country will need 150,000 megawatts in electric power installations, mostly in the South-Central region. Because potential hydroelectric power sources are distant from centers of consumption, a supplement on the order of 70,000 megawatts from nuclear power will be needed by the year 2000. Brazil's nuclear development began in the 1950's when technical personnel were trained; by 1965 three experimental reactors had been installed.

During 1976, the Government continued to move forward with plans to construct Brazil's first uranium concentration plant, to be located adjacent to uranium deposits at Poços de Caldas in Minas Gerais. The plant, scheduled for completion by 1979, is designed to produce 500 tons of yellowcake annually, initially utilizing only the Poços de Caldas ore. A Brazilian firm, Natron Consultoria e Projetos S/A, will supervise the $70 million project, with technology and nuclear engineering supplied by the French firm Société du Cycle de l'Uranium Péchiney Ugine Kuhlmann (PUK).

Yellowcake from the Poços de Caldas plant will be used in the country's first nuclear power facility, Angra I, a 625-megawatt pressurized water (PUR) plant under construction at Angra dos Reis near Rio de Janeiro, also scheduled for completion by 1979. The enriched uranium reactor of Angra I was being built by Furnas Centrais Electricas, a subsidiary of Centrais Electricas Brasileiras S/A (ELECTROBRAS), under contract with the Westinghouse Electric Corporation. According to Empresas Nucleares Brasileiras S/A (NUCLEBRAS), output from the Poços de Caldas concentrating facility will be sufficient to provide supplies for at least the first three power reactors to be installed in Brazil (first recharge for Angra I and initial charges for Angra II and Angra III) and perhaps supply all of the country's uranium demands until 1990. By 1985, Brazil hopes to have four nuclear powerplants completed, with a total installed power capacity of 4,200 megawatts.

As in previous years, there was no production, consumption, or export of uranium (U_3O_8) from Brazil in 1976. In its annual review of quotas for the export of nuclear-related elements, Brazil's Comissão Nacional de Energia Nuclear (CNEN) established the limits for 1976 exports of beryllium, pyrochlore, and lithium.

Prospecting efforts for new uranium deposits were monopolized by the Federal Government through its nuclear exploration and production arm, NUCLEBRAS. Private entities were permitted, however, to set up partnerships with NUCLEBRAS, provided the latter retains at least 51% control. NUCLEBRAS formed a joint prospecting and production organization, Nuclebras Auxiliar de Mineração S/A (NUCLAM), which in association with the West German firm Urangesellschaft mbH & Co. was carrying out a low-key exploratory effort for new sources of U_3O_8 with a guarantee to West Germany of a uranium supply. At yearend, Brazil's reserves of U_3O_8 were estimated to be 26,380 tons, more than double the official estimates announced in 1975. Brazil has significant world reserves of thorium, which is important for breeder reactors.

Deposit	Reserves (metric tons of U_3O_8)		
	Measured and indicated	Inferred	Total
Poços de Caldas, Minas Gerais	11,200	2,730	13,930
Figueira, Paraná	4,700	90	4,790
Amorinópolis, Goiás	1,000	2,000	3,000
Campos Belos, Goiás	--	560	560
Iron Quadrangle, Minas Gerais	--	4,100	4,100
Total	16,900	9,480	26,380

Source: Ministry of Mines and Energy. Relatorio de Atividades—1976, Federative Republic of Brazil. P. 36.

Oil Shale.—Although PETROBRAS had initially planned to begin production of oil from shale at a plant to be located in Irati (Paraná) by 1982, the company was expected to announce its intention in early 1977 to restudy the project which, based on data available at the end of 1976, was considered to be nonviable. As a result of improvements and modifications to be made to its prototype plant at São Mateus do Sul (already operating), PETROBRAS hoped to amass a more reliable data base by which to determine whether petroleum would be economically recoverable from the region's oil shale deposits.

Petroleum.—The declining trend in the production of crude petroleum since the peak year of 1974 continued in 1976. Output decreased 3% from that of 1975. The production level has remained relatively flat over the past decade. The production rate of 172,000 barrels per day required Brazil to import 82% of its crude oil needs.

Table 12.—Brazil: Crude oil production by PETROBRAS

(Thousand 42-gallon barrels)

Area	1974		1975		1976	
	Production	Percent	Production	Percent	Production	Percent
Bahia	46,898	72.4	39,973	63.7	39,489	64.7
Sergipe	9,523	14.7	10,039	16.0	10,165	16.7
Espírito Santo	1,396	2.2	1,692	2.7	1,534	2.5
Alagoas	786	1.2	994	1.6	1,566	2.5
Continental Shelf	6,152	9.5	10,070	16.0	8,272	13.6
Total	64,755	100.0	62,768	100.0	61,026	100.0

Source: PETROBRAS Annual Report 1974, 1975, and 1976.

The cost of importing crude oil increased 24% to $3.8 billion, representing a major item in Brazil's balance of payments. The average price paid for crude oil during 1976 was $11.50 per barrel compared with an average price of $1.50 paid during the 1960's. The quantity of crude oil imports increased 16%, and came primarily from Iraq, Saudi Arabia, Kuwait, Iran, and Libya. Total apparent consumption of petroleum products in 1976 increased 8.8%, compared with a 5.6% increase in 1975. Consumption of automobile gasoline increased only 0.3% as a result of price increases and distribution restrictions.

Through its State-owned oil monopoly PETROBRAS, the Brazilian Government continued in 1976 to emphasize exploration and development of the offshore Campos Basin, located 240 kilometers northeast of Rio de Janeiro. At least 13 oil-bearing structures have been identified in the region, which has been officially estimated to contain as much as 800 million barrels of oil. Since 1970, when the area was first explored, a total of 37 wells have been drilled in the Campos Basin. There were no changes in the estimate of the production potential of the Basin of 200,000 barrels per day by the early 1980's. A total expenditure of $3.7 billion would be required to bring the field into full production.

By the end of 1976, nine oilfields had been discovered in the Campos Basin: Garoupa, Namorado, Badejo, Pargo, Bagre, and four new unnamed fields. The temporary undersea production system for the Garoupa Field was planned for startup in early 1977 with an eventual capacity of 45,000 to 50,000 barrels per day. Namorado, the largest Campos field discovered with potential reserves of 400 million barrels, was expected to be developed after Garoupa.

PETROBRAS increased its oil exploration budget to $395 million in 1976 resulting in the discovery of several notable oilfields on the Continental Shelf off Amapá Territory, Rio Grande do Norte, and the highly promising Enchova Field in the Campos Basin. Nationwide, PETROBRAS drilled 111 exploratory wells, of which 48 were on land and 63 offshore, a 35% increase over 1975 drilling. At year-end 1976, proved oil reserves increased 12% to 877 million barrels, including 22

million barrels of natural gas liquids, primarily as a result of development of the Garoupa, Namorado, and Enchova oilfields.

On February 16, 1976, PETROBRAS issued an announcement to foreign oil companies concerning prequalification procedures for exploration and development operations under a service contract (with risk clause) program authorized by the Government in October 1975. In the announcement 10 blocks were specified, totaling 34,000 square kilometers. Out of 40 foreign oil firms prequalified by PETROBRAS, only 11 firms paid the $400,000 fee for the geological data package covering the initial areas open for bids. By the limit date of June 15, six proposals were presented.

By yearend, risk contracts had been signed with BP Petroleum Development Brazil Ltd. and a consortium headed by Shell Exploration Services. Negotiations were completed with the joint venture of Elf Aquitaine Brésil and Agip S.p.A., but the contract had not been signed. Negotiations were still in progress with Exxon Corp. and Texaco Inc.

The Mineral Industry of Bulgaria

By Tatiana Karpinsky [1]

Bulgaria is a small country but has well-developed industries including energy, ferrous and nonferrous metallurgy, machine-building, metalworking, chemical, and petrochemical. In 1976, industrial enterprises built with Soviet financial aid and technical assistance accounted for about 96% of the ferrous and 85% of the nonferrous metals output, nearly 80% of the oil refining and petrochemical products, approximately two-thirds of the electrical power, and a predominant part of the chemical products.

In 1976, industrial production and national income increased 8.2% and 7%, respectively, well below the initially planned rates of 9.2% and 9%.[2] Ferrous and nonferrous metallurgy provided some 6% of Bulgaria's industrial production.

Capital investment increased from 4.6 billion leva (L) in 1975 to L5.5 billion in 1976.[3] About 54% of this was used for renovation and development of existing industrial facilities.

Machine-building and metallurgy continued to be the most significant sectors of Bulgaria's economy. Output of the machine-building industry increased 13% (planned, 14.4%), ferrous metallurgy 13.1%, the chemical industry 5.1% (planned, 13.4%), and construction materials 8.1% (planned, 13.1%).[4] Labor productivity, expected to rise more than 8%, increased only 7%. These figures indicate that most of the 1976 targets were not met.

Bulgaria's chief industrial problems were labor shortages, unused production capacity in certain sectors, and poor management. The following percentage increases, however, were reported for 1976: Pig iron 3.3%, crude steel 8.6%, rolled steel 10.4%, and electrical energy 9.9%. Coal production fell 8.5%.

The total number of industrial workers and employees in State enterprises was 1,171,000 in 1975. The number of workers and employees in State mineral and energy enterprises, by branch, is given in the following tabulation:

Branch	Workers and employees (thousands)
Engineering and metalworking industry	321.0
Fuel industry	51.6
Ferrous metallurgy (including ore mining)	31.0
Production of electricity and steam heat and power	[1] 19.5

[1] Statisticheski Godishnik na Narodna Republika B'lgariya 1976 (Statistical Yearbook of the People's Republic of Bulgaria 1976). Sofia. 1976, p. 155.

Bulgaria is poor in fuel-energy resources. About 97% of Bulgarian coal consists of lower rank lignite and brown coal. The country's domestic reserves of petroleum and natural gas are nearly depleted. Reserves of ores for ferrous metallurgy are insufficient in terms of requirements. Newly developed reserves of nonferrous metal ores show a declining trend in metal content.

Bulgaria continued to participate in many multilateral investment projects for the production of natural gas, petroleum, asbestos, iron ore, ammonium phosphate, and other products on Soviet territory. In

[1] Foreign mineral specialist, International Data and Analysis.
[2] Vanshna Targovia (Foreign Trade), Sofia. No. 7, 1977, pp. 25–26.
[3] The official exchange rate from Bulgarian leva (L) to U.S. dollars and Soviet rubles in 1976 was L0.96=US$1.00=0.75 ruble.
[4] Rabotnichesko Delo (Labor Review), Sofia. Feb. 3, 1977, p. 1.

exchange, Bulgaria is to receive annually 40,000 additional tons of asbestos, 2.8 billion cubic meters of gas, 850,000 tons of iron ore and concentrate, and other raw materials.

The U.S.S.R. accounted for about 55% of Bulgaria's total trade in 1976. Bulgaria, in turn, ranked third in the U.S.S.R.'s total trade with 8%, preceded only by East Germany and Poland. In 1977, Bulgarian-Soviet trade is to increase 11% to 4,800 million rubles.[5]

Plans have been developed for a railway ferry between the seaports of Ilyichevsk (U.S.S.R.) and Varna (Bulgaria).

Government Policies and Programs.—Bulgaria's economy is centrally planned and controlled by the Government. The 1977 annual plan foresees an increase of 8.2% in the national income, 9.2% in gross industrial output, and 8% in labor productivity.[6] Major growth is planned in the machine-building, chemical, and metallurgy industries. Engineering output is to increase 16.7% and chemical production 15.9%.

The 1977 annual plan calls for the generation of 30.7 billion kilowatt-hours of electrical energy and foresees an increase of 20% in coal production. Total coal production is to reach 30.7 million tons, including 23 million tons of lignite, 7.1 million tons of brown coal, 430,000 tons of bituminous coal, and 130,000 tons of anthracite.[7]

Plans for the steel industry include the output of 1.7 million tons of pig iron (up 9%), 2.7 million tons of steel (up 9.8%), and 2.9 million tons of rolled products (up 5.2%).

Capital investment is to total L5.7 billion in 1977, a 3.6% increase over that of 1976. Investment in production of coal is to reach L108 million. Bulgaria is planning to accelerate development of the Troyanovo 3, Bobov Dol, Merichleri 3, and Ing. St. Seimenliysky (Black Sea) coal mines and to renovate the Marshal Tolbukhin mine at Pernik. The planned increase in coal production is to result in the following output levels: Maritsa-East, 2.5 million tons; Bobov Dol, 400,000 tons; and other Maritsa mines, 200,000 tons.[8]

Construction projects of national importance to be continued into 1977 include extension of the Kozloduy atomic powerplant, completion of the third power station (840 megawatts) at the Maritsa-East power complex, and completion of the Belmeken-Sestrimo hydroelectrical power complex in the Rila and Rhodope Mountains. Projects for 1977 also include reconstruction of the Kremikovtsi and Lenin metallurgical combines, expansion of the Burgas petroleum refinery, expansion of a copper-producing combine at Pirdop, development of the Elatsite copper concentration combine, and other projects.

The final targets of the seventh 5-year plan (1976–80) were approved by the Eleventh National Party Congress. During the 1976–80 period, the Bulgarian Government is to continue to accelerate industrialization. Industrial production is to increase about 170%, mainly as a result of increased labor productivity. In 1980, Bulgaria is to produce 4.1 million tons of steel, 3.7 million tons of rolled ferrous metals, and 38 million tons of coal. Production of electrical power is to reach 38 billion kilowatt-hours. About 3,000 megawatts of new capacity is to be brought into operation.

Prospecting for ores, petroleum, natural gas, nonmetal deposits, and quarry material is to continue at a steady pace.

[5] Vanshna Targovia (Foreign Trade), Sofia. No. 10, 1977, p. 4.
[6] Rabotnichesko Delo (Labor Review), Sofia. Oct. 30, 1976, p. 1.
[7] Vuglishta (Coal), Sofia. February 1977, p. 3.
[8] Pages 3–4 of work cited in footnote 7.

PRODUCTION

Total coal production in Bulgaria decreased from 27.8 million tons in 1975 to 25.5 million tons in 1976. Brown coal production decreased from 7.3 million tons in 1975 to 6.7 million tons in 1976. Reportedly, the decline in coal production resulted from the renovation of a number of mines and labor shortages.

In 1976, production of iron ore at 2.3 million tons remained far below expanding national requirements. An additional 1.6 million tons was imported during the year. Production of pig iron amounted to 1.6 million tons, compared with 1.5 million tons in 1975.

Crude steel production in 1976 reached

2.5 million tons, compared with 2.3 million tons in 1975. In order to expand the steel industry in 1976, Bulgaria continued to modernize the Kremikovtsi and Lenin steel plants. Plans are to build a third major steelworks in the near future. The expansion program in the steel industry is expected to be completed in 1982.

In 1976, refined copper production increased about 1.9% over that of 1975 and reached 53,000 tons. The Medet open pit mine accounted for 80% of total mine output. Development of the new open pit copper mine Elatsite, with a planned capacity of 10 million tons of ore per year, started in 1976. During 1976, new copper reserves were proved in Bulgaria's copper deposits.

Smelter production of lead and zinc in 1976 was approximately the same as in 1975, at about 112,000 tons and 92,000 tons, respectively. The main lead-zinc producer was Gorubso Mining Enterprise which accounted for 70% of total Bulgarian production. Intensive prospecting for lead-zinc ores continued in 1976; as a result, proved reserves increased 40%.

Bulgaria also mined small quantities of tungsten, molybdenum, and manganese.

Production of crude oil continued to decline as output reached 117,000 tons, 4.1% below the 1975 level. An additional 11.9 million tons of crude oil was imported from the U.S.S.R. Natural gas production was also slightly below the 1975 level. Bulgaria imported 2.2 billion cubic meters of natural gas from the U.S.S.R.

Production of electrical energy was 27.7 billion kilowatt-hours, up from 25.2 billion kilowatt-hours in 1975. About 18% of the total output came from the Kozloduy atomic powerplant.

Table 1.—Bulgaria: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Cadmium, smelter output [e] ---------- tons	200	220	220
Copper:			
Mine output, metal content ---------- do	50,000	55,000	57,000
Blister, including secondary ---------- do	48,000	60,000	60,000
Refined, electrolytic, including secondary [e] ---------- do	47,000	52,000	53,000
Iron and steel:			
Iron ore and concentrate ----------	2,685	2,337	2,317
Pig iron, including blast furnace ferroalloys ----------	1,528	1,560	1,632
Crude steel ----------	2,188	2,265	2,460
Semimanufactures ----------	2,242	2,495	2,756
Lead:			
Mine output, metal content [e] ----------	110	[r] 108	110
Smelter, including secondary [e] ----------	112	[r] 110	112
Manganese ore:			
Gross weight ----------	34	35	40
Metal content ----------	10	10	11
Molybdenum, mine output, metal content [e] ---------- tons	140	140	140
Silver [e] ---------- thousand troy ounces	800	800	1,000
Zinc:			
Mine output, metal content [e] ---------- tons	80,000	80,000	85,500
Smelter, including secondary ---------- do	90,000	91,600	92,500
NONMETALS			
Asbestos ---------- do	700	700	300
Cement, hydraulic ----------	4,297	4,358	4,362
Clays, kaolin ----------	210	203	194
Fertilizer materials:			
Manufactured:			
Nitrogenous:			
Gross weight ----------	[r] 1,589	1,820	NA
N content ----------	[r] 593	672	NA
Phosphatic:			
Gross weight ----------	[r] 551	760	[e] 750
P_2O_5 content ----------	188	246	242
Ammonia ----------	980	1,136	NA
Gypsum and anhydrite:			
Crude ----------	246	236	232
Calcined ----------	42	40	40
Lime (quicklime) ----------	1,312	[e] 1,300	[e] 1,600
Pyrite, gross weight ----------	244	150	256
Salt, all types ----------	130	[e] 130	[e] 90
Sodium and potassium compounds:			
Caustic soda ----------	72	88	90
Sodium carbonate, calcined ----------	655	1,009	[e] 1,000
Sulfur: [e]			
From pyrite ----------	105	105	110
Byproduct, all sources ----------	140	142	155
Total ----------	245	247	265
MINERAL FUELS AND RELATED MATERIALS			
Coal (marketable):			
Anthracite ----------	117	118	99
Bituminous ----------	190	212	196
Lignite and brown ----------	23,998	27,515	25,184
Total ----------	24,305	27,845	25,479
Coke ----------	1,308	1,364	1,408
Natural gas, marketed ---------- million cubic feet	6,344	3,905	3,637
Petroleum:			
Crude:			
As reported ----------	144	122	117
Converted ---------- thousand 42-gallon barrels	1,051	891	854
Refinery products:			
Gasoline ---------- do	13,175	14,195	NA
Kerosine ---------- do	1,240	1,279	
Distillate fuel oil ---------- do	21,634	22,007	
Residual fuel oil ---------- do	32,301	33,167	
Lubricants ---------- do	490	560	
Asphalt, including natural ---------- do	1,666	2,120	
Total ---------- do	70,506	73,328	NA

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, bismuth, chromite, gold, silver, barite, fluorspar, magnesite, palladium, platinum, tellurium, and uranium are also produced but information is inadequate to make reliable estimates of output levels.

TRADE

In 1976, Bulgaria's foreign trade turnover (value of imports plus exports) amounted to L10,636 million, an increase of L859 million or 8.8% over that of 1975. Total exports were valued at L5,200 million, an increase of L659 million or 14.5%, and the value of imports rose to L5,436 million, an increase of L200 million or 3.8%. The balance-of-trade deficit decreased from L695 million in 1975 to L236 million in 1976. In 1976, Bulgaria's foreign trade turnover with Council for Mutual Economic Assistance (CMEA) countries[9] was approximately 80% of its total turnover, trade with developed market economy countries about 13%, and trade with developing market economy countries about 7%. Bulgaria's largest trading partner in 1976 was the U.S.S.R., with 54.4%. Its second largest trading partner among CMEA countries was East Germany, followed by Czechoslovakia, Poland, Romania, and Hungary.[10] Imports from the U.S.S.R. comprised primarily machinery and equipment and raw materials.

In 1976, Bulgaria imported about 6.2 million tons of hard coal and 357,000 tons of coke. Almost all of the 11.9 million tons of crude oil imports came from the U.S.S.R.; imports of natural gas totaled 2,200 million cubic meters.

With the further development and modernization of Bulgarian ferrous metallurgy, imports of iron ore and concentrate reached 1.64 million tons and those of pig iron, 340,000 tons.

Bulgarian exports consisted chiefly of machinery and equipment. Other important export items were chemicals, ferrous metallurgy products, and some nonferrous metals and alloys.

According to a signed trade agreement, the value of Bulgarian-Soviet trade during the seventh 5-year plan (1976–80) is to total 24.5 billion rubles, a 76% increase over the 13.9 billion rubles of the preceding 5-year period (1971–75).

Soviet deliveries are of utmost importance to the Bulgarian economy. In 1977, the U.S.S.R. is to continue to supply most of Bulgaria's raw material, machinery, and equipment requirements. Deliveries are to include 11 million tons of oil, 6.2 million tons of coal, 3 billion cubic meters of natural gas, and 4 billion kilowatt-hours of electricity. Other supplies will include 850,000 tons of iron ore (metal content), 500,000 tons of rolled steel, and 360,000 tons of pig iron.[11]

[9] Includes the following countries: Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.
[10] Rabotnichesko Delo (Labor Review), Sofia. Oct. 9, 1976, p. 5.
[11] Vneshnyaya Torgovlya (Foreign Trade), Moscow. No. 9, 1977, pp. 13–17.

Table 2.—Bulgaria: Exports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	5,614	8,041	West Germany 3,346; Spain 2,493; Austria 1,247.
Cadmium metal including alloys, all forms	12	--	
Copper:			
Copper sulfate[2]	3,160	603	Greece 402.
Metal including alloys:			
Scrap	173	518	All to West Germany.
Unwrought and semimanufactures	r 3,120	2,199	West Germany 679; Yugoslavia 595; Poland 567.
Iron and steel metal:			
Scrap	r 106,151	143,466	Yugoslavia 48,104; Greece 44,233; Italy 39,342; Poland 11,506.
Pig iron and similar materials	r 8,892	25,968	Poland 25,595; Yugoslavia 373.
Ferroalloys	r 2,443	1,244	Hungary 975; Austria 269.
Steel, primary forms[3]—thousand tons	r 141	231	Turkey 51; Romania 44; Syria 43.
Semimanufactures:[3]			
Bars, rods, angles, shapes, sections do	139	100	Romania 44; U.S.S.R. 25; Yugoslavia 14.
Universals, plates, sheets do	423	374	West Germany 69; East Germany 61; Yugoslavia 45.
Hoop and strip do	3	3	All to Romania.
Wire do	6	5	Greece 2; Iran 1.
Tubes, pipes, fittings do	99	79	U.S.S.R. 38; Poland 12; Cuba 10; East Germany 10.
Total do	670	561	
Lead:			
Oxides	2,038	900	Italy 358; Spain 220; Japan 118.
Metal including alloys, all forms	r 20,798	9,711	Yugoslavia 6,143; Italy 3,295; Spain 273.
Magnesium metal including alloys, all forms	80	--	
Manganese ore	6,000	8,000	NA.
Nickel metal including alloys:			
Scrap	NA	324	All to West Germany.
Unwrought and semimanufactures	173	350	Netherlands 238; United Kingdom 62; West Germany 50.
Platinum-group metals and silver:			
Waste and sweepings—value, thousands	$79	$77	All to Switzerland.
Metals including alloys:			
Platinum-group do	--	$361	France $241; West Germany $120.
Silver do	$6,196	$1,158	West Germany $969; Austria $189.
Zinc metal including alloys:			
Scrap	45	103	All to Portugal.
Unwrought and semimanufactures[4]	22,639	21,406	Czechoslovakia 8,000; United Kingdom 5,542; Yugoslavia 2,739.
Other:			
Ash and residue containing nonferrous metals	161	--	
Oxides, hydroxides, peroxides of metals, n.e.s	7	14	All to United Kingdom.
Metals including alloys, all forms:			
Metalloids—value, thousands	$58	$219	All to United States.
Base metals including alloys, all forms, n.e.s	4,520	6,944	U.S.S.R. 6,789.
NONMETALS			
Barite	r 97,675	93,913	U.S.S.R. 85,320; Poland 8,593.
Cement[2]—thousand tons	143	87	Syria 26; U.S.S.R. 10.
Clays and clay products:			
Crude:			
Fire clay	20	3,068	All to Hungary.
Kaolin	r 8,916	8,667	Do.
Unspecified	13,464	11,897	Italy 7,643; Yugoslavia 2,599; Greece 1,655.
Products:			
Refractory	--	496	All to Greece.
Nonrefractory	53,595	7,587	All to Yugoslavia.
Diamond, industrial—value, thousands	$38	$473	All to Belgium-Luxembourg.
Fertilizer materials:			
Nitrogenous[2]	556,214	601,934	India 100,646; Greece 28,245; Cuba 25,888.
Ammonia	1,873	6,241	Greece 5,163; Yugoslavia 1,078.

See footnotes at end of table.

Table 2.—Bulgaria: Exports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Sodium and potassium compounds, soda ash [2]	336,971	656,138	U.S.S.R. 445,350; Hungary 84,481; Czechoslovakia 39,787.
Stone, sand and gravel:			
Dimension stone, crude and partly worked	r 5,864	7,839	West Germany 3,902; Hungary 2,736; Poland 1,201.
Gravel and crushed stone	2,147	6,914	All to Hungary.
Sulfur, sulfuric acid [2]	31,366	16,582	Romania 10,768.
Talc	24,139	30,950	All to U.S.S.R.
Other:			
Crude	5,143	--	
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture	6,777	4,363	All to Italy.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	3	41	All to Yugoslavia.
Refinery products:			
Gasoline ---do---	--	16	All to Greece.
Kerosine ---do---	--	8	All to Hungary.
Distillate fuel oil ---do---	r 12	200	Sweden 106; West Germany 86; Hungary 8.
Residual fuel oil ---do---	7	--	
Lubricants ---do---	r 130	53	Belgium-Luxembourg 32; France 10; Spain 6.
Other:			
Liquefied petroleum gas --do---	173	151	Greece 90; Yugoslavia 61.
Nonlubricating oils, n.e.s --do---	39	44	All to Yugoslavia.
Mineral jelly and wax ---do---	9	7	Yugoslavia 4; Austria 3.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	9,702	7,851	Yugoslavia 4,451; France 1,070; Spain 943.

r Revised. NA Not available.

[1] Unless otherwise specified, data are partially or wholly compiled from the 1975 edition of the United Nations World Trade Annual and the 1974 edition of the United Nations Supplement to the World Trade Annual, as well as official trade statistics of selected trading partner countries (Czechoslovakia, East Germany, Hungary, Poland, Romania, and the U.S.S.R.).

[2] Official Bulgarian Trade Statistics.

[3] United Nations. Statistics of World Trade in Steel, 1974 and 1975 editions, New York. 1975 and 1976.

[4] Excludes quantities to Austria valued, in thousands, at $2,676 in 1974 and $765 in 1975.

Table 3.—Bulgaria: Imports of selected mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite	45	40	All from Hungary.
Alumina	1,888	681	All from Italy.
Metal including alloys:			
Unwrought	22,834	23,866	U.S.S.R. 23,516; Austria 350.
Semimanufactures	23,325	19,192	U.S.S.R. 9,931; West Germany 3,345; Yugoslavia 2,493.
Copper:			
Ore and concentrate	9,764	3,900	All from Belgium-Luxembourg.
Copper sulfate	8,132	7,881	All from U.S.S.R.
Metal including alloys, all forms	r 6,435	6,761	U.S.S.R. 4,112; Poland 697; West Germany 565.
Iron and steel:			
Iron ore [2] thousand tons	2,396	1,918	U.S.S.R. 1,678.
Metal:			
Scrap	r 2,126	1,048	All from Poland.
Pig iron [2] thousand tons	340	330	U.S.S.R. 322.
Ferroalloys do	15	12	U.S.S.R. 11.
Steel, primary forms do	r 646	940	U.S.S.R. 939.
Semimanufactures: [3]			
Bars, rods, angles, shapes, sections do	r 515	508	U.S.S.R. 346; Italy 38; Czechoslovakia 34; Poland 30.
Universals, plates, sheets do	r 321	289	U.S.S.R. 200; West Germany 19; Poland 19.
Hoop and strip do	r 22	20	West Germany 8; Italy 3; U.S.S.R. 2.
Rails and accessories do	r 63	56	U.S.S.R. 44; Czechoslovakia 5; France 2.
Wire do	r 22	24	West Germany 6; U.S.S.R. 6; Austria 3.
Tubes, pipes, fittings do	r 114	93	West Germany 41; U.S.S.R. 15; Poland 7.
Castings and forgings, rough do	(4)	(4)	All from West Germany.
Total do	r 1,057	990	
Lead:			
Ore and concentrate	--	638	All from Greece.
Oxides	659	31	All from Austria.
Metal including alloys, all forms value, thousands	$32	--	
Manganese:			
Ore and concentrate thousand tons	130	126	All from U.S.S.R.
Oxides	210	70	All from Japan.
Mercury 76-pound flasks	290	--	
Nickel metal including alloys, all forms	r 800	600	West Germany 390; Japan 129.
Platinum-group metals including alloys, all forms value, thousands	$566	$156	All from West Germany.
Silver metal including alloys do	$147	--	
Tin:			
Oxides	15	15	Do.
Metal including alloys, all forms	95	187	All from Spain.
Titanium oxides	2,011	968	Italy 638; West Germany 180; Spain 150.
Tungsten metal including alloys, all forms	[5] 4	3	United Kingdom 2; Japan 1.
Zinc ore and concentrate	568	12,867	United Kingdom 11,000; Greece 1,867.
Other:			
Ores and concentrates of molybdenum, tantalum, titanium, vanadium, zirconium	478	243	All from United Kingdom.
Ash and residue containing nonferrous metals	--	17,403	All from Yugoslavia.
Oxides, hydroxides, peroxides of metals, n.e.s	19	27	West Germany 20; Japan 7.
Metals including alloys, all forms:			
Metalloids	[6] 691	680	Yugoslavia 580; Italy 100.
Alkali, alkaline earth, rare-earth metals	2	--	
Base metals including alloys, all forms, n.e.s	16,531	17,973	U.S.S.R. 17,972.

See footnotes at end of table.

Table 3.—Bulgaria: Imports of selected mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	60	4,000	All from Greece.
Dust and powder of precious and semi-precious stones, value, thousands	$153	$350	All from Belgium-Luxembourg.
Grinding and polishing wheels and stones	r 1,214	1,712	Hungary 687; Austria 465; Italy 327.
Hard alloys	16,850	18,055	All from U.S.S.R.
Corundum, artificial	463	999	All from Yugoslavia.
Asbestos	32,564	28,812	Do.
Boron materials, oxide and acid	--	200	All from Italy.
Cement, thousand tons	r 142	186	U.S.S.R. 175; Hungary 11.
Clays and clay products (including all refractory brick):			
Crude	r 2,076	293	All from Hungary.
Products:			
Refractory (including nonclay bricks)	31,454	38,676	U.S.S.R. 29,583; Austria 2,642; West Germany 2,060.
Nonrefractory	447	186	All from West Germany.
Diamond, industrial, value, thousands	$222	$527	All from Belgium-Luxembourg.
Feldspar and fluorspar	1,857	223	All from West Germany.
Fertilizer materials:			
Crude:			
Phosphatic (apatite concentrates)	426,213	432,117	All from U.S.S.R.
Potassic (salts)	86,211	86,211	Do.
Manufactured:			
Phosphatic	185,298	206,547	U.S.S.R. 191,657; Yugoslavia 14,890.
Mixed	510	--	
Magnesite	r 368	4	All from Hungary.
Pigments, mineral: Iron oxides, processed, value, thousands	$29	$74	All from Japan.
Sodium and potassium compounds, caustic soda	14,246	3,772	West Germany 2,247; Italy 1,498.
Stone, sand and gravel:			
Gravel and crushed rock	2,678	2,424	All from Hungary.
Sand, excluding metal bearing	--	322	All from Italy.
Sulfur	r 50,783	56,379	Poland 49,000; U.S.S.R. 7,379.
Other:			
Crude	104	489	Greece 400; United Kingdom 89.
Oxides and hydroxides of magnesium, strontium, barium	252	165	All from France.
Bromine, iodine, fluorine	6	--	
MINERAL FUELS AND RELATED MATERIALS			
Carbon black [2]	22,632	25,688	U.S.S.R. 21,610; Romania 1,554; East Germany 1,108.
Coal, all grades, thousand tons	6,183	6,400	U.S.S.R. 6,006; Poland 394.
Coke [2], do	357	357	U.S.S.R. 280; Poland 31; Czechoslovakia 21.
Gas, natural, million cubic feet	10,839	41,848	All from U.S.S.R.
Petroleum:			
Crude [2], thousand 42-gallon barrels	78,042	76,843	U.S.S.R. 72,478.
Refinery products:			
Kerosine, do	r 8	18	Hungary 15; Yugoslavia 3.
Distillate fuel oil, do	9	15	All from Greece.
Residual fuel oil, do	23	37	Do.
Lubricants, do	36	54	Netherlands 14; United Kingdom 12; France 8.
Other:			
Mineral jelly and wax, do	3	--	
Nonlubricating oils, n.e.s., do	7	8	United Kingdom 5; Netherlands 2.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	13,254	7,983	U.S.S.R. 7,776.

r Revised.

[1] Unless otherwise specified, data are partially or wholly compiled from the 1975 edition of the United Nations World Trade Annual and the 1974 edition of the United Nations Supplement to the World Trade Annual, as well as official trade statistics of selected trading partner countries (Czechoslovakia, East Germany, Hungary, Poland, and the U.S.S.R.).

[2] Official Bulgarian Trade Statistics.

[3] United Nations. Statistics of World Trade in Steel, 1974 and 1975 editions, New York. 1975 and 1976.

[4] Less than ½ unit.

[5] Excludes quantity valued at $55,000.

[6] Excludes quantity valued at $86,000.

COMMODITY REVIEW

METALS

Aluminum.—In 1976, construction of the Shumen aluminum processing complex continued. The complex is to produce 48,000 tons of rolled aluminum products per year starting in 1978, but the 1976 annual plan for construction of the plant was not fulfilled. Imports of aluminum ingot from the U.S.S.R. were estimated at 25,000 tons.

Copper.—Copper ore production was estimated at 12.3 million tons and electrolytic copper at 53,000 tons. The copper consumed in Bulgaria is supplied entirely by indigenous production. In 1976, about 80% of the country's copper ore was supplied by the 8-million-ton-per-year-capacity Medet mine; the remainder came from the Chelopech (underground), Burgas, Panagyurishte, and other mines.

Medet copper ore is surface mined and contains about 0.36% copper, 0.008% molybdenum, and 0.81% sulfur. The main minerals are chalcopyrite, pyrite, and molybdenite. The Medet open pit mine uses a fully automated, computerized truck-haulage control system. The Chelopech mine (near Sofia) is Bulgaria's largest underground copper mine and has a capacity of 500,000 tons of ore per year. The ore at Chelopech contains 0.5% to 1.5% copper. One of the major Bulgarian projects in the copper industry during 1976 was the development of a new open pit copper mine at Elatsite, about 50 miles northeast of Sofia.[12] The Elatsite mine has a design capacity of 10 million tons per year (0.45% copper content). Ore reserves at Elatsite are estimated at 250 million tons.

Mineral exploration activity increased near Burgas on the Black Sea coast. Detailed investigations were made at Rosen, Meden Rid, Cherveno Zname, V'erly Briay, and other mining fields of Burgaski Medni Mini (Burgas Copper Mines).

During the seventh 5-year plan, a geological survey of the Burgas mines is to continue, with planned investments of L5.0 million for drilling, L5.0 million for a mining survey, and L1.8 million for geophysical investigations. It is expected that new reserves of copper ore will be discovered in seven mining areas, the most promising of which is the Rosen area.[13]

During 1976–80, large planned investments are to develop the mining industry, including copper mining. The G. Damyanov ore-dressing plant at Pirdop is to be modernized and two other ore-dressing plants are to be built by the end of the 5-year plan.

Iron and Steel.—Production of iron ore in Bulgaria totaled 2,317,000 tons in 1976, a decrease of 0.9% from the 1975 level and 13.7% from the 1974 level. Total imports of iron ore and concentrate amounted to 1.64 million tons. The U.S.S.R. has for many years been the chief source of iron ore for Bulgaria. Total consumption of iron ore was 3.96 million tons, a decrease of 8.1% from that of 1975. Bulgaria's principal iron ore deposits are located at Kremikovtsi, north of Sofia. The ore is basically limonite (70%), siderite (18%), and hematite (12%). Iron ore reserves at Kremikovtsi are estimated at about 250 million tons; they are surface mined. The deposits have a high content of other components: About 18% barite, 12% manganese, and 0.8% lead.[14] In 1976, new technology was introduced at the mine, resulting in a higher degree of mechanization in the mining and loading of ore.

The iron ore mined at Kremikovtsi is delivered to the Kremikovtsi metallurgical complex which also receives iron ore imported from the U.S.S.R. Total production of pig iron (excluding ferroalloys) in Bulgaria was 1.56 million tons in 1976, an increase of 3.3% over that of 1975. Imports of pig iron reached 0.34 million tons, approximately the same as in 1975.

Bulgaria produced 2.46 million tons of crude steel, an 8.6% increase over that of 1975. Bulgaria's share in world crude steel production was 0.37%. It is anticipated that output will reach 2.7 million tons in 1977 and 4.1 million tons in 1980. Oxygen-blown steel accounted for about 57.7% of Bulgaria's steel output, the open-hearth process for about 20.9%, and the electric-furnace process for 21.7%.

Production of rolled steel was 2.8 million tons; about 1 million tons of ingot

[12] Rabotnichesko Delo (Labor Review), Sofia. Dec. 22, 1976, pp. 1–2.
[13] Rudodobiv (Ore Mining), Sofia. No. 5, 1977, pp. 3–5.
[14] Bulgarian Foreign Trade, Sofia. No. 1, 1977, p. 14.

steel was imported from the U.S.S.R. to supply rolling mills. Rolled steel imports totaled 618,173 tons and exports, 43,340 tons. Expansion of the Kremikovtsi integrated iron and steel complex continued in 1976.

Lead and Zinc.—Estimated production of metal content of lead was 110,000 tons and of zinc, 85,500 tons. Bulgaria has an exportable surplus of lead and zinc metals. Bulgaria exported 4,500 tons of zinc to the United Kingdom, 2,600 tons to Italy, 2,580 tons to France, and 5,000 tons to Czechoslovakia. About 8,000 tons of lead was also exported.

Bulgaria has numerous lead-zinc deposits. Although complex lead-zinc ore bodies are scattered over various regions of the country, the more significant ones are located at Madan, Kardjali, Smolian, Rudozem, Ustrem, Martinovo, Osogova, Chiprovtsi, and Vratsa. All Bulgarian lead-zinc ore bodies are mined by underground methods. The main deposits are veined and the others are stratified masses or bedded deposits.

Bulgaria has several lead-zinc mining enterprises; Gorubso Mining Enterprise maintained its lead in production, accounting for about 70% of the national output. The ores at the Gorubso mines average approximately 2.7% lead and 2.4% zinc. Bulgaria has been consistently expanding the productive capacities of existing mines and ore-processing facilities.

In 1976, deep drilling proved the existence of new lead-zinc ore deposits. The best results thus far were achieved in the Gorubso lead-zinc ore fields. A new field was also discovered in the Haskovo region where several million tons of ore was identified.

During the 1971–75 period, L77.9 million was allocated for geological investigations of lead-zinc deposits. Investments are to increase 11% to L86.5 million during the 1976–80 period.[15]

Large investments are to be made in the mining and metallurgical industry during the current 5-year plan. Renovation of many lead-zinc mines and plants is planned. The development plan foresees the introduction of advanced technology and automation in mines and smelters. New, highly productive beneficiation equipment is to be put into operation in all new plants.[16]

NONMETALS

Cement.—Cement production in 1976 was 4.4 million tons, unchanged from that of 1975. Reportedly, the Cement and Lime Production State Economic Trust did not fulfill its annual goals. The national production goal for cement in 1980 was set at 8.5 million tons. The 1976–80 plan provides for development of machines and equipment necessary for the cement, ceramics, and construction materials enterprises.

Construction of two additional production lines with a total annual capacity of 2 million tons at the Devnya cement works continued during the year. By 1980, the sixth technological line at the Wilhelm Pieck cement works at Beli Izvor, near Vratsa, is to have an annual production of 550,000 tons.

Fertilizer Materials.—Bulgaria is expanding its production of mineral fertilizers. After the Devnya complex near Varna was commissioned in 1974, the national productive capacity of compound fertilizer facilities increased 70%.[17]

In the first 6 months of 1976, according to Bulgarian reports, production of fertilizers increased 9% over that of the same period in 1975. A total of 658,000 tons of chemical fertilizers (elemental content) was supplied to the agricultural sector in 1976.

Bulgaria is self-sufficient in nitrogenous fertilizers. In 1976, the country exported about 200,000 tons of nitrogenous fertilizers (nitrogen content). The main purchasers of the nitrogenous fertilizers and urea were India, Egypt, the People's Republic of China, Iran, and Indonesia. Some Bulgarian fertilizers went to Western Europe. Estimated imports of phosphatic and potassic fertilizers were about 38,000 tons (P_2O_5 content) and 50,000 tons (K_2O content), respectively.

During 1977–80, development of fertilizer plants is to continue at Devnya, Stara Zagora, and Dimitrovgrad. A new line producing 1,360 tons of ammonia per day will be built at Dimitrovgrad. Two sulfuric acid lines at Devnya are to be modernized

[15] Rudodobiv (Ore Mining), Sofia. No. 6, 1976, pp. 2–3.
[16] Rudodobiv (Ore Mining), Sofia. No. 7, 1976, p. 21.
[17] Economical Cooperation of the CMEA Member Countries, Moscow. No. 5, 1976, p. 91.

to use elemental sulfur. The chemical works at Stara Zagora and Dimitrovgrad are to be adapted to use natural gas feedstock. A new nitrogenous fertilizer plant is to be built at Varna, with a capacity of 1,800 tons of urea per day. Bulgaria is to produce about 716,000 tons of nitrogenous and 450,000 tons of phosphatic fertilizers per year by the end of 1980.

The fertilizer application goal for 1980 is 250 kilograms of nutrient per hectare of arable land. Reportedly, Bulgaria is interested in a joint undertaking with Angola for the production of chemical fertilizers.

MINERAL FUELS

Production of total primary energy derived from fossil fuels and hydroelectric and nuclear generation in Bulgaria decreased from 15.2 million tons of standard coal equivalent in 1975 to 14.7 million tons in 1976. The share of coal (lignite, brown, and bituminous) and coke in total primary energy production was 91.1%, crude oil 1.4%, natural gas 0.7%, hydroelectrical energy 2.7%, and nuclear energy 4.1%.

Total consumption of primary energy increased from 40.8 million tons of standard coal equivalent in 1975 to 41.9 million tons in 1976. Coal provided about 47.5% of the total, oil 42.0%, natural gas 7.1%, hydroelectrical energy 1%, nuclear energy 1.4%, and imported energy 1%.

The total installed capacity of electrical powerplants in Bulgaria was 7,063 megawatts, up from 6,912 megawatts in 1975. Energy production reached 27.7 billion kilowatt-hours, a 9.9% increase over that of 1975; the share of nuclear energy in total electrical energy output was 18% and that of hydroelectrical energy, 12%.

During 1976, 0.5 billion kilowatt-hours of electrical energy was exported and 4.0 billion kilowatt-hours was imported. Bulgaria's first nuclear powerplant, located near Kozloduy on the Danube, was commissioned in September 1974. The powerplant employs two of the Voronezh-type 440-megawatt reactors. The installed capacity of the Kozloduy powerplant is expected to reach 1,760 megawatts in 1980.[18]

Bulgaria's largest hydroelectric complex, the Belmeken-Sestrimo cascade, with three power stations and a total capacity of 755 megawatts, was scheduled to be completed in 1977. The Dospat-Vŭcha cascade in southern Bulgaria, with a projected capacity of 550 megawatts, was also under construction in 1976. Energoproekt of Sofia and Bucharest Power Engineering Institute are jointly preparing plans for the Nikopol-Turnu Magurele hydroelectrical power complex.

The plan for 1976–80 calls for construction of an 840-megawatt thermal powerplant, Maritsa-East 3, and a 630-megawatt unit at the Varna thermal plant, and further development of thermal plants at Plovdiv, Ruse, Abram Stoyanov, and Sofia.

[18] Energetica (Energy), Sofia. July 1977, pp. 4–7.

Table 4.—Bulgaria: Total primary energy balance for 1975 and 1976

(Million tons of standard coal equivalent [1])

	Total primary energy	Coal (lignite and bituminous) and coke	Crude oil and petroleum products	Natural gas	Hydroelectrical energy	Nuclear energy	Turnover of electrical energy
1975:							
Production	15.2	14.1	0.2	0.3	0.3	0.3	--
Imports	25.6	6.6	17.0	1.6	--	--	0.4
Exports	--	--	--	--	--	--	--
Apparent consumption	40.8	20.7	17.2	1.9	.3	.3	.4
1976:							
Production	14.7	13.4	.2	.1	.4	.6	--
Imports	27.3	6.5	17.4	2.9	--	--	.5
Exports	.1	--	--	--	--	--	.1
Apparent consumption	41.9	19.9	17.6	3.0	.4	.6	.4

[1] 1 ton standard coal equivalent (SCE)=7,000,000 kilocalories. Conversion factors used are as follows: Hard coal, 1.0; lignite and brown coal, 0.5; crude oil, 1.47; natural gas, 1.33 (per thousand cubic meters); and hydroelectrical and nuclear energy, 0.125 (per thousand kilowatt-hours).

Source: Statisticheski Godishnik na Narodna Republika B'lgariya 1976 and 1977 (Statistical Yearbook of the People's Republic of Bulgaria 1976 and 1977), Sofia. 1976 and 1977.

Coal.—Bulgaria produced a total of 25.5 million tons of coal (including 295,000 tons of bituminous coal and anthracite), a decrease of 8.5% from that of 1975. Coal production in 1977 is expected to reach 30.7 million tons, including 23.0 million tons of lignite, 7.1 million tons of brown coal, 430,000 tons of bituminous coal, and 130,000 tons of anthracite.[19] Coal production in 1980 is expected to reach 38 million tons, and in 1990, about 50 million tons.[20]

Coal imports amounted to 6.2 million tons, including 3.5 million tons of anthracite. About 5.8 million tons came from the U.S.S.R. and 0.4 million tons from Poland. During the 10 years from 1966 to 1975, imports of bituminous coal increased 280%.

Production of coke reached 1.4 million tons in 1976. Imports amounted to 357,000 tons, mainly from the U.S.S.R.

Consumption of coal in the various internal market sectors in Bulgaria in 1975 was as follows, in thousand tons:

	Bituminous coal and anthracite	Brown coal and lignite
Coke-oven plants	2,366	--
Powerplants	2,366	18,176
Iron and steel industry	1,191	1,304
Transportation	268	96
Other	1,844	4,412

Almost all of Bulgaria's coal deposits are located in the southern and western part of the country. At present, Bulgaria has about 5 billion tons of lignite available for development. An additional 1 billion tons of reserves may be proved as exploration proceeds at the more promising deposits now classified as probable.[21]

The largest reserves of lignite are found at the Maritsa-East lignite basin, located near the town of Zagora. This basin has over 2.9 billion tons of reserves, of which 2.1 billion tons in seven mine fields is suitable for surface mining.[22] The Maritsa-East Basin's surface-mined output accounted for about 60% of total coal production. Lignite reserves totaling about 180 million tons are located at the Maritsa-West coal fields, and about 560 million tons, near Sofia.

Brown coal reserves are concentrated mainly in the western and southwestern part of the country in the Bobov Dol, Pernik, and Pirin Basins, and are estimated at about 350 million tons.

A few score million tons constitute the brown coal reserves of the Burgas Basin, situated near Burgas. Hard coking coal reserves are found in the Balkan coal field, situated in the eastern part of the Balkan mountain range. Reserves in the Balkan coal basin are estimated at 30 million tons of hard coal.

Reserves in the recently discovered Dobrudzha Basin, in the northeastern part of Bulgaria, are estimated at over 1.5 billion tons of hard coal. The economic advantage of developing this basin has already been proven.

Development continued in 1976 of new mines brought into operation in 1975, including the Troyanovo 3 lignite open pit (3 million tons per year) and the Bobov Dol (500,000 tons per year) and Merichleri 3 (300,000 tons per year) mines, both underground brown coal mines. Soviet assistance and machinery and equipment imported from the U.S.S.R. and East Germany are being used in the development of these mines.

The seventh 5-year plan foresees development of the Maritsa-East complex, which is to produce 22 million tons of coal annually by 1980, as well as modernization of the Troyanovo 1 mine and development of the Troyanovo 2 mine. The Bobov Dol brown coal mine is to reach design capacity of 1.5 million tons per year in 1980.

Natural Gas.—Production of natural gas rose from 73.2 million cubic meters in 1965 to 473.6 million cubic meters in 1970 and then gradually declined to 110.6 million cubic meters in 1975. In 1976, estimated production of natural gas was 103 million cubic meters. Estimated imports of natural gas from the U.S.S.R. totaled 2.2 billion cubic meters.

Most of Bulgaria's gas production comes from the Chiren gas reserves in the northwestern part of Bulgaria, with some from the region of Varna, near the Black Sea. New sources of natural gas have been found along the coast at the Golden Sands resort; the towns of Balchik, Kavarna, and

[19] Work cited in footnote 7.
[20] Work cited in footnote 6.
[21] Rudnichar (Miner), Sofia. July 11, 1974, pp. 1–2.
[22] Ninth World Mining Congress, West Germany. III-23, May 1976, p. 2.

Michurin; Cape Kaliakra; and near the mouth of the Kamchiya River. Prospecting for oil and gas will continue in 1977–80.

Gas was first delivered to Bulgaria from the U.S.S.R. across Romania by a new pipeline in August 1974. In Bulgarian territory, the gas pipeline runs through Devnya to Pleven Vratsa and Sofia.

Work continued on construction of the southern branch of the Soviet-Bulgarian pipeline. This segment will be 267 kilometers long and is to supply the chemical plants in southern Bulgaria in 1980. Bulgaria is also to receive 2.8 billion cubic meters of gas per year from the Orenburg pipeline starting in the fourth quarter of 1978. Bulgaria, together with the U.S.S.R., is building a 516-kilometer section of this pipeline crossing the Carpathians. The Orenburg gas pipeline has a total length of 2,750 kilometers and a projected capacity of 24 billion cubic meters per year.

Petroleum.—Crude petroleum production in Bulgaria increased from 200,000 tons in 1960 to 334,000 tons in 1970 and decreased to about 122,000 tons in 1975.[23] In 1976, indigenous production of crude oil was 117,000 tons, a decline of 4.1% from that of 1975. Bulgaria imported 11.9 million tons of crude petroleum and petroleum products from the U.S.S.R. Some additional crude oil was imported from Iraq, Iran, Libya, Algeria, Nigeria, and Egypt. Total imports of crude petroleum increased from 12,000 tons in 1960 to 11,553,000 tons in 1975. Imports of petroleum products increased more than 300% from 800,000 tons in 1960 to 2,600,000 tons in 1975.

Bulgaria had three operating refineries in 1976 with a total capacity of 15 million tons per year. Construction of plants for processing petroleum and manufacturing petroleum products continued at Burgas.[24]

During 1976–80, about 40% of the capital investment allocated for the chemical industry is to be spent on expansion of existing plants and construction of new petroleum processing capacity.

In 1976, a major effort was underway to find crude oil reserves in the northern and northwestern part of the country. Deep drilling started on newly discovered prospective formations and is to continue during 1977. Development of the oilfield at Dolna-Lukovitsa, discovered in 1975, continued in 1976.

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[23] Statisticheski Godishnik na Narodna Republika B'lgariya 1976 (Statistical Yearbook of the People's Republic of Bulgaria 1976), Sofia. 1976. p. 176.

[24] Rabotnichesko Delo (Labor Review), Sofia. Sept. 30, 1977, p. 1.

The Mineral Industry of Burma

By Gordon L. Kinney [1]

Burma's economic situation showed a modest but encouraging upswing in fiscal 1976.[2] The gross domestic product (GDP) in 1976 was estimated at $3.7 billion[3] in current dollars. At constant 1969 prices the GDP rose an estimated 5.6% to $1.8 billion.[4] This was a considerable improvement over Burma's 10-year average growth rate of less than 3%, which had barely exceeded the population growth, leaving per capita GDP growth negligible during the decade. Per capita income at current prices rose an estimated 15% during 1976 to about $118, over twice the 1975 gain of 7%. The balance of payments showed a $28 million deficit in 1975, and estimates for 1976 indicated a slight increase in the deficit to around $30 million.

Inflation was still the main economic problem as the amount of currency in circulation continued to increase and bottlenecks in production, transportation, and distribution kept the supply of goods low. Speculators, hoarders, smugglers, and black marketeers added to inflation. In recent years, the inflation rate has been well over 20%. The consumer price index in Rangoon (1972=100) was at 222 in 1975, an increase of nearly 35% over that of the previous year. In 1976, however, consumer prices were held to a 20% increase, closing the year at about 266. Similarly, the wholesale agricultural price index climbed 20% in 1976.

The major bright spot in the economic picture was the vital agricultural sector, which had an increase in output of about 7% over that of 1975, the largest increase in the past 15 years. Production of all major crops except jute rose for the 1975–76 crop season, mainly because of excellent climatic conditions during the year. These favorable conditions continued throughout the 1976–77 crop season, and Burma was expected to have a record harvest for the second consecutive year. Rice production in 1976 could be over 9 million tons and again contribute the major portion of Burma's export income.

Burma's mineral production was mixed during the year, with some products making modest gains. These included antimony, copper, mixed tin-tungsten concentrates, gypsum, limestone, and crude petroleum. A number of the minerals most important to the economy, however, showed declines in production. Foremost among these were the products from the famed Bawdwin mine—lead, zinc, and silver. Silver was particularly disappointing, with production falling 73% to 211,000 troy ounces.[5]

Substantially increased crude oil production was a great help in keeping fuel import bills from contributing to the already high rate of inflation. The Government had not imported crude oil since 1974, thereby saving millions of dollars in foreign exchange but causing a decline in production in many industries because of recurring petroleum shortages. The shortages were caused not so much by lack of crude oil production capacity as by a continuing difficulty in transporting and distributing the petroleum products on a timely basis.

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[1] Physical scientist, International Data and Analysis.

[2] The Burmese fiscal year begins April 1 of the year stated.

[3] Where necessary, values have been converted from Burmese kyat (K) to U.S. dollars at the rate of K6.7=US$1.00.

[4] U.S. Embassy, Rangoon, Burma. Economic Trends: Burma. State Department Airgram A–5, Feb. 1, 1977, p. 3.

[5] U.S. Embassy, Rangoon, Burma. Industrial Outlook Report: Minerals. State Department Airgram A–44, June 17, 1977, pp. 1–7.

The value of output of the mineral sector was not available for 1976. However, the order of magnitude at constant prices should be approximately the same as in the previous year. A decrease in the value of metallic minerals produced was balanced by the increase in value of petroleum and natural gas production. The significance of the mineral sector has gradually declined in recent years, contributing only a little over 1% of the GDP in 1976. The reported output value of the mineral sector for 1975 was $49 million at current prices, a slight decrease from $51 million in 1974.[6]

About 67,000 people or 0.6% of the 12-million-person labor force in Burma were employed in the mining sector during 1975. They produced about 1.5% of the net output of goods and services during the period.

In an effort to develop and promote the mining industry, the Government of Burma and the United Nations Development Program (UNDP) allocated $480,000 and $640,000, respectively, to strengthen the technical capability of the Planning and Research Department of the Myanma Mineral Development Corp. (MMDC). MMDC is responsible for exploiting Burma's mineral resources and developing new mining enterprises.

The immediate objectives of the project will be to establish and equip research and development facilities for mineral beneficiation and metallurgy, to train engineers and technicians in production-oriented research and the planning of mineral development projects, and to prepare a feasibility study for the establishment of a 20,000-ton-per-year metallurgical works based on the Monywa copper prospect.

The electric power industry continued to expand in 1976. Total installed capacity was provisionally reported at 452,000 kilowatts, a 15% increase over that of 1975. Total power generated during 1976 was about 850 million kilowatt-hours, about 5% over that of 1975. A major new use of natural gas in Burma was for the generation of electric power at gas turbine powerplants. The installed capacity of turbines fueled with natural gas nearly doubled in 1976 to over 103,000 kilowatts. These plants now account for over 23% of Burma's total capacity, one of the highest proportions of natural gas-fueled turbines to total capacity in the world.

PRODUCTION

Burma's overall production of metallic ores and coal decreased in 1976. Petroleum and natural gas had significant increases. Again in 1976 the value of oil production was estimated at more than twice that of other mineral output. Total tin-tungsten production was apparently up about 3%. Neither the grade of the concentrates nor the value of the production was available from official sources in 1976, making comparisons and conclusions difficult and liable to change. Production of lead, zinc, and silver, mainly from the Bawdwin mine, dropped. Antimony continued a 5-year climb to a record high production for Burma. Industrial minerals had a mixed year: Cement, limestone, bentonite, industrial white clay, and gypsum all had healthy increases, while barite, talc, and fire clay showed moderate decreases for the year.

Total onshore petroleum production in 1976 increased more than 20% over the 1975 figure. The increase came from the Mann oilfield; other producing fields declined in output. There was no offshore petroleum or natural gas production in 1976.

Natural gas production jumped an impressive 42% to meet increased demand from fertilizer and cement plants and gas turbine powerplants.

[6] Ministry of Planning and Finance. Report to the Pyithu Hluttaw on the Financial, Economic, and Social Conditions of the Socialist Republic of the Union of Burma for 1976–77. 1976, pp. 10–21.

Table 1.—Burma: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Antimony, mine output, metal content [e]	[r] 420	[r] 540	570
Copper:			
Mine output, metal content [e]	[r] 70	[r] 85	90
Matte, gross weight	159	191	205
Iron and steel:			
Crude steel [e]	[r] 40,000	[r] 40,000	40,000
Semimanufactures	[e] 30,000	[e] 35,000	NA
Lead:			
Mine output, metal content [e]	9,300	[r] 10,000	3,350
Smelter:			
Refined lead	[r] 9,295	9,955	3,331
Antimonial lead (18% to 20% antimony)	359	251	187
Manganese ore, gross weight	[e] 280	--	--
Nickel:			
Mine output, metal content [e]	22	19	24
Speiss, gross weight	87	77	94
Silver, mine output thousand troy ounces	722	775	211
Tin, mine output:			
Metal content of tin concentrate	[r] 482	545	262
Metal content of tin-tungsten concentrate	252	277	523
Total	[r] 734	822	785
Tungsten, mine output:			
Metal content of tungsten concentrate	[r] 220	217	108
Metal content of tin-tungsten concentrate	173	253	479
Total	[r] 393	470	587
Zinc, mine output, metal content	[r] 4,361	4,115	2,211
NONMETALS			
Barite [2]	[e] 15,000	15,444	13,696
Cement, hydraulic thousand tons	172	228	233
Clays: [2]			
Ball clay	[r] 2,055	4,296	5,080
Bentonite	[r] 512	915	955
Fire clay [3]	[r] 2,496	3,617	2,792
Industrial white clay	[r] 1,536	2,489	4,393
Feldspar [2]	[r] 198	762	904
Graphite [2]	305	87	--
Gypsum [2]	30,085	39,260	45,296
Precious and semiprecious stones: [2]			
Jadeite kilograms	8,808	7,598	9,046
Unspecified thousand carats	NA	76	NA
Salt thousand tons	125	96	[e] 100
Sand: [2]			
Glass sand, brown	NA	5,283	NA
Glass sand, white	NA	2,710	NA
Stone: [2]			
Dolomite	[r] 420	887	1,016
Limestone, crushed and broken thousand tons	[r] 524	595	802
Quartz	[r] 151	386	177
Talc and related materials, soapstone [2]	[r] 347	418	355
MINERAL FUELS AND RELATED MATERIALS			
Coal	16,811	24,588	20,930
Gas, natural: [e] [4]			
Gross production million cubic feet	[r] 5,320	[r] 7,130	9,410
Marketed production do	[r] 4,900	[r] 5,500	7,800
Petroleum:			
Crude thousand 42-gallon barrels	7,581	6,700	8,183
Refinery products:			
Gasoline do	[r] 1,497	1,506	1,645
Jet fuel do	223	166	[e] 188
Kerosine do	1,686	1,440	1,117
Distillate fuel oil do	1,691	1,463	2,045
Residual fuel oil do	1,020	1,489	[e] 2,002
Other do	519	619	[e] 719
Refinery fuel and losses do	763	307	[e] 461
Total do	[r] 7,399	6,990	8,177

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, Burma also produces pottery clay, common sand and gravel, other varieties of crude construction stone, and other varieties of gem stones, but available information is inadequate to make reliable estimates of output levels.

[2] Data are for fiscal years beginning April 1 of that stated.

[3] Includes fire clay powder.

[4] Based on reported figures for fiscal years beginning April 1 of that stated.

TRADE

Mineral products ranked third in value of exports after agriculture and forestry products in 1976. The estimated value of Burma's exports was over $235 million and import values were estimated at $296 million, giving a balance-of-trade deficit of about $60 million. Exports of base metals and ores and silver were provisionally reported at $6 million or about 2.6% of total exports. Imports of base metals and base metal manufactures were valued at over $20 million. This was 30% less than in 1975, reversing the steady increase of the last 2 years. Coal and coke imports dropped to an insignificant level from 1975's record high value of $12 million.

Table 2.—Burma: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1973	1974	Principal destinations, 1974
METALS			
Antimony ore and concentrate	582	476	Japan 217; Belgium-Luxembourg 203.
Copper matte	--	350	All to West Germany.
Lead metal, unwrought, refined	7,500	4,713	People's Republic of China 4,463; Malaysia 200.
Nickel matte and speiss	--	350	All to West Germany.
Silver, unwrought ----thousand troy ounces--	722	420	United Kingdom 126; Netherlands 101; Japan 99.
Tin ore and concentrate	2,365	334	Malaysia 212; Spain 91.
Tungsten:			
Tungsten concentrate	955	809	West Germany 303; Japan 300; United States 175.
Mixed tin-tungsten concentrate	342	432	Netherlands 203; Belgium-Luxembourg 132; United Kingdom 97.
Zinc ore and concentrate	6,487	6,947	All to Belgium-Luxembourg.
Other metals including alloys, all forms	3	71	Singapore 64.
NONMETALS			
Cement	(1)	5,000	All to India.
Diamond, industrial ----------value--	NA	$42,281	All to West Germany.
Fertilizer materials, unspecified	--	25,040	Indonesia 15,000; Pakistan 5,000; Philippines 2,540.
Gem stones, excluding diamond:			
Jade:			
Uncut ----------thousand carats--	96	7,979	Mainly to Hong Kong.
Cut but not set ----------do----	3,227	1,940	Israel 1,447; Hong Kong 299; Switzerland 147.
Ruby ----------carats--	NA	1,994	Lebanon 1,134; Switzerland 174.
Sapphire ----------do----	NA	2,755	Italy 1,985; Switzerland 344; People's Republic of China 185.
Unspecified ----------do----	10,000	89	All to Switzerland.
Salt	4,015	2,011	All to Singapore.
Other nonmetals	26,626	(1)	All to People's Republic of China.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products thousand 42-gallon barrels--	196	152	Japan 65; Spain 6.

NA Not available.
[1] Less than ½ unit.

Table 3.—Burma: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1973	1974	Principal sources, 1974
METALS			
Aluminum:			
Oxide and hydroxide	r 16	2	Mainly from Japan.
Metal including alloys:			
Unwrought	r 2	227	Hong Kong 198; U.S.S.R. 29.
Semimanufactures	r 420	321	West Germany 116; U.S.S.R. 60.
Chromium oxide and hydroxide	1	(2)	All from Japan.
Copper:			
Ore and concentrate	--	4	Netherlands 2; United Kingdom 2.
Copper sulfate	1	(2)	All from Japan.
Metal including alloys:			
Unwrought	3	7	India 5.
Semimanufactures	r 250	230	Japan 128; United Kingdom 34.
Iron and steel including alloys:			
Pig iron, including cast iron	2,957	1,548	Finland 1,331; Japan 217.
Ferroalloys	46	--	
Steel, primary forms	r 13,253	2,965	All from Republic of Korea.
Semimanufactures	31,923	31,294	Japan 19,389; People's Republic of China 2,525.
Lead metal including alloys, all forms	4	16	Hong Kong 13.
Manganese oxide	r 89	182	All from Japan.
Mercury ---76-pound flasks	1,045	94	Japan 44; Denmark 38.
Nickel metal including alloys, all forms	r 5	31	All from West Germany.
Silver metal including alloys, all forms troy ounces	147	--	
Tin metal including alloys, unwrought and semimanufactures	3	150	Mainly from Japan.
Titanium oxide	r 33	36	West Germany 26; People's Republic of China 10.
Zinc:			
Oxide	r 140	68	West Germany 43; United Kingdom 16.
Metal including alloys, all forms	r 476	308	Japan 273; India 26.
Other:			
Ores and concentrates, n.e.s	1	1	All from Hong Kong.
Oxides, hydroxides, peroxides of metals, n.e.s	r 216	201	Japan 172.
Base metals including alloys, all forms	r 12	(2)	All from United Kingdom.
NONMETALS			
Abrasives, natural, n.e.s --value, thousands	$58	$69	People's Republic of China $27; Japan $15.
Asbestos	r 662	150	All from People's Republic of China.
Boric acid	1	13	United States 11.
Bromine	(2)	--	
Cement	2,024	699	West Germany 656.
Chalk	1	136	People's Republic of China 76; India 49.
Clays and clay products:			
Crude:			
Kaolin (china clay)	29	8	All from United Kingdom.
Other	88	58	Japan 34; United Kingdom 24.
Products:			
Refractory ---value, thousands	$149	$325	Japan $312.
Nonrefractory ---do	$63	$92	People's Republic of China $82.
Fertilizer materials:			
Manufactured:			
Nitrogenous	27	--	
Phosphatic	11,248	7,497	All from Tunisia.
Ammonia	r 100	20	West Germany 8.
Graphite, natural	r 9	(2)	All from India.
Gypsum ---value, thousands	(2)	(2)	All from People's Republic of China.
Iodine	(2)	1	All from United Kingdom and Japan.
Mica, all forms	r 11	1	All from Japan and People's Republic of China.
Precious and semiprecious stones, except diamond ---carats	33	--	
Salt	40	408	Japan 407.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	r 5,254	5,400	People's Republic of China 2,864; West Germany 1,163; Netherlands 965.
Caustic potash, sodic and potassic peroxides	1	4	Belgium-Luxembourg 3.

See footnotes at end of table.

Table 3.—Burma: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1973	1974	Principal sources, 1974
NONMETALS—Continued			
Stone, sand and gravel:			
Quartz and quartzite	r 15	46	People's Republic of China 36; United Kingdom 10.
Sand excluding metal bearing	425	--	
Sulfur:			
Elemental	r 1,732	832	West Germany 819.
Sulfuric acid	4	1	Mainly from United Kingdom.
Other nonmetals, crude	r 11	1	All from West Germany.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	r 182	113	Japan 99; People's Republic of China 10.
Coal and briquets:			
Anthracite and bituminous	64,460	151,842	India 66,946; Australia 56,199; People's Republic of China 28,697.
Lignite and lignite briquets	12,340	--	
Coke and semicoke	2,032	--	
Hydrogen, helium, rare gases	r 7	1	All from United States and Japan.
Petroleum:			
Crude ---thousand 42-gallon barrels--	--	1,486	All from Indonesia.
Refinery products:			
Kerosine and jet fuel ---do---	350	(2)	All from United Kingdom.
Residual fuel oil ---do---	115	16	Mainly from Bahrain.
Lubricants ---do---	131	20	Singapore 5; United Kingdom 3; United States 3.
Other:			
Mineral jelly and wax ---do---	1	(2)	Mainly from West Germany.
Nonlubricating oils ---do---	5,245	25	All from People's Republic of China.
Petroleum asphalt and pitch ---do---	243	49	Japan 39.
Unspecified ---do---	(2)	--	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r 6	266	Mainly from Italy.

r Revised.
[1] Imports for consumption only; does not include imports into bond.
[2] Less than ½ unit.

COMMODITY REVIEW

METALS

Antimony.—Production of antimony ore increased for the fifth consecutive year. The 1,122 tons of ore mined in 1976 was nearly double the 1971 figure. The UNDP was conducting an exploratory drilling program at Lebin in an effort to evaluate the ore body. The site has long been worked by individual miners.

Copper.—Detailed drilling of the Monywa copper prospect (22°07′ N, 95°08′ E), about 80 kilometers west of Mandalay, continued during the year. The drilling, undertaken with assistance from the UNDP and a Japanese firm, is expected to be completed by mid-1978. Preliminary estimates of the size and grade of the deposit have ranged from 60 million to 200 million tons of ore and from 0.7% to 1.0% copper in the form of easily milled chalcocite. Pyrite occurs with the copper mineralization in sufficient quantity to produce sulfuric acid as a byproduct. The Japanese proposed construction of an 8,000-ton-per-day mine and a mill producing 20,000 tons of concentrate per year, but this was apparently not satisfactory to the Government of Burma. The Government wanted to obtain copper smelting facilities as well as the concentration plant. West Germany continued the interest shown in 1975 to invest in the project and could be chosen to finance and build the mill and smelter.

Exploration of a copper prospect at Shangalon (23°42′ N, 95°31′ E), 190 kilometers north of Mandalay, was abandoned because of disappointing results from the exploratory drilling.

Lead, Zinc, Silver.—Production of most of Burma's lead, zinc, and silver continued to come from the Bawdwin mine over 200 kilometers northeast of Mandalay. Production of lead and zinc concentrates dropped about 66% and 46%, respectively. Refined lead and byproduct silver production also fell. The higher-grade ores were becoming less plentiful and harder to recover. Much of the mining equipment was of pre-World War II vintage and no longer operated efficiently. Topping the equipment problems at the mine were the unstable security conditions in the northern Shan State area. West Germany was reluctant to invest in a large-scale modernization of the mine in 1975, and the security conditions apparently had not improved significantly in 1976. A small amount of equipment updating was planned for 1976, but no results were evident by yearend, as seen by the poor production figures.

Some of West Germany's loan commitment for 1975 was reportedly scheduled for use in construction of a small zinc smelter at Ela (19°37′ N, 96°13′ E). The smelter, which would be Burma's first, would presumably refine zinc from the Bawdwin mine's slag and tailings piles. The tailings have been accumulating since the startup of modern mining activity in 1905.

Tin and Tungsten.—Modernization of the Myanma Tin and Tungsten Corporation's Heinda mine was nearly completed and the mine should begin operating in 1977. The project was financed by West Germany with Krupp Industries as the major contractor. The new capacity was planned at 1,000 tons per year of tin concentrate.

The World Bank's International Development Association (IDA) was reportedly ready to approve a $16 million loan to cover the foreign exchange costs of developing tin-tungsten production at the Heinze Basin, 280 kilometers southeast of Rangoon. The project was to include construction of a dredge and associated support facilities for the Basin. In addition, facilities at the nearby Kanbauk mine were to be improved, a new tin and tungsten concentrating plant built at Tavoy (14°05′ N, 98°12′ E), 80 kilometers south of the Heinze Basin, and the gravel mines at Tavoy rehabilitated. Completion of the project could increase mineral export earnings by $6 million annually. Current production from the area is mostly by small-scale private miners who sell their production to the State.

Overall production of tin concentrate, tungsten concentrate, and mixed tin-tungsten concentrate was nearly 2,100 tons, an increase of about 3% over the 1975 figure.

NONMETALS

The country's three cement kilns labored during the year to keep up with increased domestic demand. Production took a sizable jump to 255,000 tons in 1976, a 43% increase over the 178,000 tons (revised) in 1975. The three kilns were all located at Thayetmyo (19°19′ N, 95°11′ E) on the Irrawaddy River about 310 kilometers north of Rangoon.

Gypsum production increased 15% in support of the increased cement output.

Ceramic Industries Corp. was negotiating with Asahi Glass Co., Ltd., of Japan for a sheet glass plant at yearend. The plant would be located at Bassein (16°47′ N, 94°44′ E) and could make Burma self-sufficient in sheet glass by 1979. Glass sand would be obtained locally.

MINERAL FUELS

Coal.—Despite an increased demand for coal from industry and the Burma Railway system, production decreased 15% to under 21,000 tons in 1976. The major mines located at Kalewa and Nama were unable to supply the demand. A reported 177,000 tons of coal was imported during 1976.

Petroleum and Natural Gas.—Development of oilfields continued during the year with a total of 26 onshore development wells completed. Most of the 18 wells drilled at the Mann oilfield proved to be good producers. Four wells at the Letpando oilfield proved unproductive, further dimming hopes of significant production from the field. Four wells were drilled at Myanaung and Shwepyitha with only one at Shwepyitha showing good natural gas production.

Despite the efforts at further development, production at the Chauk, Prome, and Myanaung Fields continued to decline. The introduction of gas-lift and water-drive secondary recovery systems at the

Yenangyaung Field arrested that Field's production decline.[7]

Exploration drilling was apparently down slightly from 1975 levels; however, areas of the Irrawaddy Delta and the upper Chindwin River drainage basin were explored by Myanma Oil Corporation's geological survey and seismic teams. By the end of June 1976, six exploration wells had been drilled throughout the country. Only one of these was encouraging, a hole drilled at Yenanma south of the Mann oilfield.

Of the 19 offshore wells contracted, 17 unsuccessful wells had been drilled off the western and southern coasts of Burma by yearend. Because of the poor results, no further offshore wildcat drilling was planned. The four international firms operating in the offshore area had ceased drilling by autumn 1976. Esso Co. drilled four wells to complete its eight-well contract, Total CFP Birmanie drilled two wells to complete its requirement of three wells, and Arakan Oil Development Corp. drilled one well to complete its required five wells. Martaban-Cities Service, Ind., drilled one well in 1976 but did not drill the final two holes required to fulfill its contract obligations. No oil was discovered in commercial quantity in any of the areas drilled. Total struck a potentially commercial natural gas deposit off the Arakan coast, but its offshore location will make exploitation presently impractical.

It was expected that during 1977 the Government would offer international tender announcements for both relinquished areas and some choice new offshore drilling blocks.

Chronic transport problems continued to disrupt the flow of crude oil and refined products during the first half of 1976. However, after midyear the water transport fleet was rejuvenated by the addition of 10 imported push tugs, 10 imported self-propelled barges, and 20 domestically built oil barges. New rail tank cars and highway tanker trucks were also to be added to the system as funds become available.

To further upgrade the transport system, several additions to the pipeline network were begun or completed during the year. The most important was the start of construction of the 218-kilometer crude oil pipeline (25.4 centimeters in diameter) from the Mann oilfield to Prome. By midyear, the first 88 kilometers had been completed. The project was continuing at yearend and was to be completed by mid-1977. A 51-kilometer pipeline from the Yenangyaung oilfield to the Chauk refinery was completed in October. A 112-kilometer pipeline was completed in April between the Letpando oilfield and the Chauk refinery. The line was idle, however, as there was no production from the Letpando oilfield.

A Chase Manhattan banking consortium agreed to lend Burma $39 million toward construction of a 280-kilometer pipeline and the purchase of five drilling rigs. The pipeline will connect the oil facilities at Prome with the refinery at Syriam south of Rangoon. Construction of the pipeline would eliminate the slow and costly river barge traffic presently used to deliver most of the crude oil to the Syriam refinery.

The Japanese Government agreed to loan Burma nearly $100 million toward equipment and services for the construction of a 25,000-barrel-per-day refinery. Total cost of the refinery will be $132 million. It will replace the present 6,800-barrel-per-day Chauk refinery, which is to be scrapped. The new refinery will process the increased crude oil production from the Mann oilfield.

A production record of 8.2 million barrels was set for crude oil in 1976, representing a 22% increase over the 1975 figure of 6.7 million barrels. The production target for 1977 was set at 10.95 million barrels. Burma's crude oil production was small by world standards but ranked fifth in the Far East area.

Both of Burma's refineries, Syriam and Chauk, continued to process all of the country's crude output, but final 1976 product output breakdowns were not available.

Petroleum product supplies from the refineries, however, did not satisfy the increasing domestic demand, particularly during the first half of 1976. Shortages of diesel oil and furnace fuel caused many industries to close temporarily or operate well below normal capacity. The situation was improving toward yearend; the transport improvements noted earlier provided

[7] U.S. Embassy, Rangoon, Burma. Petroleum Outlook Report: Burma. State Department Airgram A-22, Apr. 12, 1977, pp. 1-12.

a smoother flow of crude oil to the refineries and of petroleum products to consumers.

Marketed natural gas production reached 7.8 billion cubic feet (221 million cubic meters) in 1976, a 42% increase over the 1975 figure. Gas production at Ayadaw and Chauk was stepped up to meet the increased requirements of the Kyunchaung (Ayadaw) and Sale (Chauk) fertilizer plants. The Shwepyitha gasfield near Myanaung was brought into production during the year to supply the new units at the Myanaung gas turbine powerplant and the Kyangin cement mill.

The Mineral Industry of Canada[1]

By Charlie Wyche [2]

In 1976, the Canadian mining industry gave some indications of recovery from the recession that began in 1974 and resulted in weakened demand and decreased prices of mineral products during 1975. During the first quarter, both production and demand were up substantially for most mineral commodities. However, economic growth was curtailed during the second and third quarters, and by yearend, the rate of economic growth had slowed considerably.

Overall domestic and foreign demand for Canadian minerals increased during 1976, but market conditions fluctuated widely among commodities. Although markets improved for iron ore, molybdenum, asbestos, and flat-rolled steel products, they remained weak for many nonferrous metals, structural steel products, and construction materials. In some cases, market conditions were too weak to support price levels sufficient to provide reasonable returns on invested capital. Price increases announced by nickel, copper, and zinc producers had to be reduced when actual demand fell far short of projected demand.

Strikes and lockouts, resulting from labor disputes, affected the production of aluminum, lead, zinc, and nickel during the year. Strikes occurred not only because labor was seeking higher wages from companies, but also to protest wage rollbacks ordered by the Anti-Inflation Board.

Despite these adverse economic and labor conditions, a new production record was set in 1976 for the Canadian mineral

[1] The Canadian Minerals Yearbook for 1976 and the Canadian Mineral Survey for 1976, both prepared by the Mineral Development Sector, Department of Energy, Mines and Resources, Ottawa, are sources of more detailed information on the mineral industry of Canada. The 1977 and succeeding Canada chapters of the Minerals Yearbook, Volume III, will be abbreviated. The Bureau of Mines has arranged to have the Canadian Minerals Yearbook placed in libraries, one in each of the 50 States and Puerto Rico, as follows: University of Alabama, University; E. E. Rasmuson Library, University of Alaska, Fairbanks; University of Arizona, Tucson; University of Arkansas, Fayetteville; California State Library, Sacramento; A. Lakes Library, Colorado School of Mines, Golden; Wilbur Cross Library, University of Connecticut, Storrs; H. M. Morris Library, University of Delaware, Newark; Strozier Library, Florida State University, Tallahassee; P. Gilbert Memorial Library, Georgia Institute of Technology, Atlanta; University of Hawaii, Hilo; Idaho University, Moscow; Morris Library, Southern Illinois University, Carbondale; Indiana University, Bloomington; Iowa State University of Science & Technology, Ames; Watson Library, University of Kansas, Lawrence; M. L. King Library, University of Kentucky, Lexington; Southwestern University, Lafayette, La.; R. H. Fogler Library, University of Maine, Orono; Eisenhower Library, Johns Hopkins University, Baltimore, Md.; Massachusetts Institute of Technology Library, Cambridge; Michigan Technical Library, Houghton; Wilson Library, University of Minnesota, Minneapolis; University of Southern Mississippi, Hattiesburg; Rolla Library, University of Missouri, Rolla; Montana State College of Mineral Science and Technology, Butte; D. L. Love Library, Nebraska Geological Survey at University of Nebraska, Lincoln; University of Nevada, Reno; University of New Hampshire, Durham; J. C. Dana Library, Rutgers University, Newark, N.J.; New Mexico Institute of Mining and Technology, Socorro; Columbia University, New York, N.Y.; D. H. Hill Library, North Carolina State University, Raleigh; Fritz Library, University of North Dakota, Grand Forks; Ohio State University, Columbus; Oklahoma State University, Norman; Multnomah County Library, Portland, Oreg.; Pennsylvania State University, University Park; University of Rhode Island, Wakefield; University of South Carolina Undergraduate Library, The Horseshoe, Columbia; South Dakota School of Mines and Technology, Rapid City; Tennessee State Library and Archives, Nashville; Main Library, University of Texas, Austin; Marriott Library, University of Utah, Salt Lake City; Bailey Library, University of Vermont, Burlington; Virginia Polytechnic Institute, Blacksburg; Washington University, Seattle; University of West Virginia, Morgantown; Memorial Library, University of Wisconsin, Madison; Coe Library, University of Wyoming, Laramie; and University of Puerto Rico, Mayaguez.

[2] Physical scientist, International Data and Analysis.

industry. According to preliminary data provided by Statistics Canada, mineral production reached a total value of $15.4 billion,[3] an increase of 14.8% over that of 1975. With respect to the national economy, value of minerals produced in Canada during 1976 represented 8.6% of the estimated $178 billion gross national product (GNP).

On the world scene, Canada ranked first in production of nickel and zinc; second in asbestos, potash, uranium, and molybdenum; third in gypsum, silver, gold, and platinum; fourth in copper and lead; fifth in aluminum metal; and sixth in iron ore. Some 62 minerals were produced from more than 300 underground and open pit mines. Canada's resource position included a wide variety of minerals; exceptions are bauxite, tin, chromium, manganese, and phosphate ores.

Exploration activity remained strong, particularly for the mineral fuels. The search for uranium proceeded in all provinces and territories. Provincial and Federal Crown corporations participated in exploration ventures, as did foreign governments. Electric power utilities, both foreign and domestic, were also financially backing uranium exploration programs. Oil and gas exploration work resulted in several discoveries in the Arctic Islands. On Newfoundland Island, in the Beaufort Sea, and offshore from Labrador, the search for oil and gas continued. A number of exploration projects were also underway for copper, lead, zinc, nickel, and the precious metals.

Regarding mineral fuel production, coal regained importance, mainly because of recent international and domestic energy events. The Organization of Petroleum Exporting Countries (OPEC) oil embargo of the early 1970's and subsequent price increases, coupled with the deteriorating petroleum and natural gas situation in Canada, all contributed to the renewed interest in coal. Several new mines, particularly in Alberta and British Columbia, were under development or planned. The Federal Government estimated that it would spend about $2.5 million on coal research and development programs during 1976. The largest portion of funds would be allocated to programs for coal gasification and liquefaction. Ontario Hydro finalized a contract with Thunder Bay Terminals Ltd. to transship some 3.2 million tons of coal annually by 1981.

Exploration for oil and gas was at an alltime high, particularly in Alberta, where drilling footage exceeded the previous record established in 1973. Pipeline construction reached a record 1,448 kilometers in 1976, chiefly as a result of a large upsurge in gasfield development. The largest project was the completion of 362 kilometers of pipeline for the Alberta Energy Co. in the British Block of southeastern Alberta. A consortium headed by Foothills Pipelines Ltd. filed an application with the National Energy Board (NEB) for permission to construct 824 kilometers of 1,067-millimeter-diameter gas pipeline in the Yukon Territory.

The question of oil and natural gas prices occupied a major position in industry developments in 1976. No general agreement on new price schedules could be reached at the first Ministers' Conference held in May, but after consultation with the producing provinces and under the authority of the Petroleum Administration Act, new prices were set.

Tax and investment policies of Federal and provincial governments continued to cause uneasiness among potential investors. There were pending legislation and changes in mineral policy and taxation during 1976 that could affect exploration and development expenditures. The most restrictive was pending legislation limiting foreign participation in the uranium industry. If a foreign group should discover a uranium deposit, it would be permitted to keep a maximum 30% equity and required to sell the remainder to Canadians. A Canadian group making a discovery was also limited to 30% equity participation, but no one foreign interest could own more than 10%.

The Ontario Legislative Assembly proposed a long-range requirement that new mining ventures in Canada be at least 75% Canadian owned. The Government would be empowered to take up to 50% equity in new ventures either by purchase or by waiver of royalties. The taxation policies of British Columbia and Manitoba, plus the program of the Province of Saskatchewan to acquire additional potash mines in

[3] Where necessary, values have been converted from Canadian dollars (Can$) to U.S. dollars at the rate of Can$1.014 = US$1.00, the average exchange rate for 1976.

the Province, added to the uncertainty. The Saskatchewan government also announced changes to the Mineral Resources Act that included new petroleum and natural gas regulations and a new royalty tax on uranium. The basic policy objectives were to provide greater Canadian control and participation, to increase the mineral processing potential, and to sell the more advanced mineral and metal forms.

PRODUCTION

Mineral production in Canada was reported from all 10 provinces and the 2 territories, with over 81% of the total value coming from Alberta, Ontario, British Columbia, and Quebec. Alberta, with over 45%, had been the leading province in mineral output value since 1971. This was due primarily to its production of crude petroleum, natural gas, and natural gas byproducts, whereas most of Ontario's value was derived from nickel, copper, zinc, iron ore, and gold. Copper and coal were the principal commodities produced in British Columbia, and asbestos, iron ore, copper, and zinc led in the value of Quebec's mineral output. Of the $15.4 billion in total value of minerals produced in 1976, contributions of the 10 provinces and 2 territories were as follows: Alberta, 45.4%; Ontario, 16.9%; Quebec, 9.9%; British Columbia, 9.2%; Saskatchewan, 5.9%; Newfoundland, 4.9%; Manitoba, 3.1%; New Brunswick, 1.7%; Northwest Territories, 1.4%; and the Yukon Territory, Nova Scotia, and Prince Edward Island, each less than 1%.

Table 1.—Canada: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum:			
Alumina, gross weight ---thousand tons--	1,265	1,134	e 455
Metal, refined ---do----	1,021	878	628
Antimony e 1	r 1,410	r 1,830	1,990
Bismuth 2	111	157	197
Cadmium 3	1,241	1,192	1,290
Calcium ---kilograms--	476,084	428,288	557,465
Cobalt:			
Mine output, Co content 4	1,564	1,354	1,373
Metal 5	326	581	797
Columbium and tantalum:			
Columbium concentrate (pyrochlore), Cb_2O_5 content	1,920	1,662	1,656
Tantalum concentrate, Ta_2O_5 content	199	179	e 180
Copper:			
Mine output, recoverable Cu content 6	821,380	733,826	747,131
Blister and anode	r 515,600	496,300	488,594
Refined	559,124	529,199	510,469
Gold ---thousand troy ounces--	1,698	1,654	1,686
Iron and steel:			
Iron ore, gross weight ---thousand tons--	49,976	46,868	56,990
Pig iron ---do----	9,422	9,150	9,801
Ferroalloys ---do----	248	160	225
Crude steel ---do----	13,623	13,025	13,136
Semimanufactures (shipments) 7 ---do----	r 10,377	9,482	e 10,000
Lead:			
Mine output, Pb content	r 301,362	352,502	247,082
Refined, primary	126,443	171,516	175,720
Magnesium, primary	r 5,948	3,826	5,858
Mercury ---76-pound flasks--	14,000	12,000	--
Molybdenum	13,942	13,027	14,415
Nickel:			
Mine output, Ni content 8	269,071	244,783	e 244,900
Smelter	r 199,900	178,000	178,000
Platinum-group metals ---troy ounces--	384,618	399,218	429,999
Selenium, refined 9 ---kilograms--	333,949	342,392	e 345,000
Silver ---thousand troy ounces--	42,810	39,695	40,887
Tellurium, refined ---kilograms--	r 9 62,610	9 40,981	24,040
Tin, mine output, Sn content	324	319	275
Titanium:			
Ilmenite, gross weight ---thousand tons--	2,017	1,544	2,115
Sorel slag (70%–72% TiO_2)	844,742	749,846	814,059
Tungsten, mine output, metal content	1,280	1,172	e 1,600
Uranium (U_3O_8)	4,350	4,679	5,137
Zinc:			
Mine output, Zn content ---thousand tons--	r 1,240	1,223	1,191
Refined, primary	426,271	426,941	472,316
NONMETALS			
Asbestos ---thousand tons--	1,644	1,056	1,549
Barite	r 78,019	81,356	65,600
Cement, hydraulic 10 ---thousand tons--	10,375	9,965	9,850
Clays and clay products 11 ---value, thousands--	r $72,217	$84,523	$93,418
Diatomite e	500	500	500
Fluorspar e	r 159,000	64,000	72,500
Gypsum and anhydrite ---thousand tons--	7,225	5,719	5,663
Lime ---do----	1,823	1,601	1,825
Magnesite, dolomite, brucite ---value, thousands--	r $4,456	$5,268	$5,189
Nepheline syenite	559,986	468,427	541,000
Potash (shipments), K_2O equivalent ---thousand tons--	5,776	4,673	5,126
Pyrite and pyrrhotite:			
Gross weight	r 48,951	21,120	30,844
Sulfur content e	r 24,476	r 10,560	16,000
Salt ---thousand tons--	5,447	4,835	6,257
Sand and gravel ---do----	r 239,296	247,155	247,660
Sodium sulfate	638,179	472,196	490,000
Stone 12 ---thousand tons--	r 92,833	89,414	87,180
Strontium minerals, celestite e	55,000	25,000	12,000
Sulfur, elemental byproduct:			
From smelter gases ---thousand tons--	663	695	781
From sour natural gas ---do----	6,949	6,572	6,200
From refineries ---do----	163	173	200
From tar sands ---do----	97	85	100
Talc, soapstone, pyrophyllite (shipments)	85,952	66,029	64,410

See footnotes at end of table.

Table 1.—Canada: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
MINERAL FUELS AND RELATED MATERIALS				
Carbon black e		113,000	r 104,000	134,000
Coal:				
Bituminous and subbituminous	thousand tons	17,382	21,771	20,812
Lignite	do	3,485	3,549	4,676
Coke, high temperature	do	5,450	5,217	5,289
Gas, natural:				
Gross production	million cubic feet	3,497,225	3,506,128	3,067,367
Marketed production	do	3,045,506	3,089,531	3,067,353
Natural gas liquids:				
Gross production:				
Butane	thousand 42-gallon barrels	r 22,138	22,916	22,451
Propane	do	r 33,212	34,850	34,016
Pentanes plus	do	r 58,031	54,454	47,586
Condensate	do	r 1,175	997	930
Total	do	r 114,556	113,217	104,983
Production returned to formation, all types	do	r 98	88	NA
Peat moss	thousand tons	369	361	360
Petroleum:				
Crude	thousand 42-gallon barrels	r 616,532	520,666	488,680
Refinery products:				
Gasoline, aviation	do	1,413	1,448	1,477
Gasoline, other	do	212,348	219,917	222,660
Jet fuel	do	23,713	24,954	25,146
Kerosine	do	25,555	25,234	27,047
Distillate fuel oil	do	164,733	154,417	159,302
Residual fuel oil	do	123,151	110,721	102,385
Lubricants	do	4,335	3,826	4,140
Other:				
Liquefied petroleum gas	do	r 8,096	8,321	10,514
Petrochemical feedstocks	do	10,390	NA	13,097
Asphalt	do	18,103	18,008	17,396
Petroleum coke	do	1,103	1,192	1,358
Unspecified products	do	r 15,407	19,133	8,757
Refinery fuel and losses	do	37,977	36,409	31,283
Total	do	r 646,324	623,580	624,562

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Antimony content of antimonial lead alloys, flue dust, and dore slag.

[2] Refined metal and bullion plus recoverable bismuth content of exported concentrate.

[3] Refined metal from domestic ores plus cadmium content of exported ores and concentrates.

[4] Actual output not reported; figure represents cobalt content of all products including cobalt in nickel sinter shipped to the United Kingdom by International Nickel Co. for further processing and cobalt in nickel copper matte shipped to Norway by Falconbridge Nickel Mines.

[5] Total cobalt content of all products produced less the amount of cobalt metal reported as produced in Norway. Thus, this figure includes cobalt content of cobalt oxide produced in Canada for sale as such as well as cobalt metal and/or chemicals.

[6] Blister copper plus recoverable copper in exported matte and concentrate.

[7] Includes shipments of ingots from primary plants for rolling elsewhere.

[8] Refined nickel plus nickel content of oxide produced plus recoverable nickel in exported matte.

[9] Refinery output from all sources, including imports and secondary sources.

[10] Cement shipped and/or used by producers.

[11] Includes value of bentonite products from common clay, stoneware clay, fire clay, and other types of clay.

[12] Crushed, building, ornamental, paving, and similar uses.

Table 2.—Canada: Value of principal mineral production in 1976
(Million dollars)

Commodity	Value
Metals:	
Copper	1,126
Gold	208
Iron ore	1,241
Lead	129
Nickel	1,232
Silver	175
Zinc	862
Other	268
Total	5,241
Nonmetals:	
Asbestos	445
Cement	539
Clay products	107
Potash	361
Sand and gravel	619
Stone	509
Sulfur	82
Other	318
Total	2,980
Mineral fuels:	
Coal	604
Natural gas	1,780
Natural gas liquids	660
Petroleum, crude	4,128
Total	7,172
Grand total	15,393

Source: Statistics Canada.

TRADE

A substantial gain in mineral exports contributed to the overall expansion in Canadian economic activity. The mining industry exported 60% of its output and accounted for about one-third of Canada's total exports. In the first 9 months of 1976, the total value of crude and fabricated nonfuel minerals exported from Canada amounted to $52 billion, an increase of 19.3% over that of the corresponding period of 1975. This was a major contribution to the country's balance of trade. In the same 9-month period, Canadian exports exceeded imports by $637 million, in contrast to the same period of 1975 when imports exceeded exports by $678 million. The value of nickel exports, among the largest earners of foreign exchange, increased 13% to $1.1 billion; that of copper, 12% to $900 million; and that of zinc, 16% to $580 million. Significant gains in export value were also recorded by iron ore (from $685.7 million to $750 million), coal (from $477.9 million to $710 million), and aluminum (from $450 million to $660 million). Precious metals exports remained around the 1975 figure of $240 million, but the values of asbestos and molybdenum exports were sharply higher.

Table 3.—Canada: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974 [1]	1975	Principal destinations, 1975
METALS			
Aluminum:			
Alumina (excluding abrasive grades), Al content	r 33,250	23,986	Mainly to United States.
Metal:			
Scrap	r 53,617	42,832	Do.
Unwrought	r 690,069	510,354	Do.
Semimanufactures [2]	r 49,291	25,074	Do.
Cadmium	r 902	643	United States 292; United Kingdom 246.
Calcium	339	310	Mainly to United States.
Cobalt:			
Metal	r 968	659	Do.
Oxides and salts, gross weight	673	561	All to United Kingdom.
Columbium concentrate [3] ---kilograms	r 4,000	9,500	All to United States.
Copper:			
Ore and matte, Cu content	344,270	314,518	Japan 226,885; United States 48,976.
Slag, skimmings, sludge, Cu content	493	102	All to United States.
Metal:			
Scrap:			
Unalloyed	r 15,937	16,475	United States 5,410; West Germany 2,825.
Copper alloys	r 23,398	13,769	United States 7,359; Italy 1,829; Japan 1,389.
Unwrought, unalloyed	r 289,649	319,716	United Kingdom 93,913; United States 65,327.
Semimanufactures:			
Unalloyed	r 45,940	26,600	United States 11,384; Iran 3,759.
Copper alloys	r 14,960	8,758	Mainly to United States.
Iron and steel:			
Iron ore ---thousand tons	37,448	36,034	United States 19,293; Japan 4,214; Netherlands 3,752.
Metal:			
Scrap ---do	r 266	420	Mainly to United States.
Pig iron and related materials ---do	570	441	United States 230; Netherlands 123.
Ferroalloys:			
Ferromanganese	r 10,295	1,240	Mainly to United States.
Ferrosilicon	r 47,650	29,101	United States 17,188; United Kingdom 10,417.
Other	r 7,040	2,024	Mainly to United States.
Steel ingots and other primary forms	r 249,508	35,499	Iran 13,182; United States 10,790.
Semimanufactures:			
Bars, rods, angles, shapes, sections	r 347,010	226,462	Mainly to United States.
Universals, plates, sheets, strip	r 648,567	508,938	Do.
Rails and accessories	r 137,613	128,404	United States 59,792; Mexico 45,890.
Wire	r 62,940	44,315	Mainly to United States.
Tubes, pipes, fittings	r 358,875	333,581	Do.
Castings and forgings, rough	r 189,847	157,367	Do.
Lead:			
Ore and concentrate, metal content	194,088	211,909	Japan 120,793; United States 24,827; West Germany 23,875.
Metal:			
Scrap, including alloy scrap	r 9,868	12,117	Republic of South Africa 3,605; Brazil 2,977; United States 1,691.
Unwrought, unalloyed	r 76,027	109,965	United Kingdom 44,306; United States 23,191.
Semimanufactures	r 9,169	6,067	Mainly to United States.
Magnesium metal	r 3,366	4,733	United States 2,573; United Kingdom 1,496.
Mercury [3] ---76-pound flasks	r 16,972	12,891	All to United States.
Molybdenum ore and concentrate, Mo content [4]	12,690	15,680	Belgium-Luxembourg 5,432; Japan 3,924; United Kingdom 2,199.
Nickel:			
Ore, matte, speiss, Ni content	85,240	84,391	United Kingdom 45,565; Norway 31,078.
Oxide, Ni content	51,118	38,527	United States 16,519; Belgium-Luxembourg 6,966; Italy 5,350.

See footnotes at end of table.

Table 3.—Canada: Exports and reexports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974 [1]	1975	Principal destinations, 1975
METALS—Continued			
Nickel—Continued			
Metal:			
Scrap	r 2,728	3,232	United States 1,300; Italy 887; Israel 337.
Unwrought	r 134,528	99,948	United States 77,492; United Kingdom 15,092.
Semimanufactures	r 9,220	10,431	United States 8,018; United Kingdom 1,945.
Platinum-group metals:			
Concentrates, residues, matte, metal content—troy ounces	524,723	433,109	Mainly to United Kingdom.
Metals:			
Scrap—do	r 31,055	21,403	United States 17,248; United Kingdom 3,168.
Other—do	r 64,227	83,548	United Kingdom 51,051; United States 29,642.
Selenium metals and salts, Se content—kilograms	r 428,100	238,680	United States 150,865; United Kingdom 85,049.
Silver:			
Ore and concentrate, Ag content—thousand troy ounces	19,383	15,156	United States 7,441; West Germany 1,460.
Metal, refined—do	r 23,576	24,235	Mainly to United States.
Tin ore and concentrate, Sn content [4]	1,316	1,052	United States 801; United Kingdom 165.
Titanium:			
Ilmenite and ilmenite sand [3 5]	r 277	200	All to United States.
Titanium slag, 70% TiO_2 [3]	167,015	192,915	Do.
Uranium and thorium concentrates—value, thousands	r $52,502	$46,256	United States $27,653; United Kingdom $17,634.
Zinc:			
Ore and concentrate, Zn content	866,697	705,144	Belgium-Luxembourg 229,735; Japan 167,149; West Germany 100,841.
Metal:			
Scrap, dross, ashes, blue powder	r 24,201	18,376	United States 12,701; United Kingdom 3,349.
Unwrought	296,777	247,280	United States 161,599; United Kingdom 56,406.
Semimanufactures	r 4,813	1,775	United States 1,419; United Kingdom 213.
Other, n.e.s.:			
Ores and concentrates, gross weight	r 611,309	254,714	West Germany 90,237; United States 88,533; Saudi Arabia 31,614.
Ash and residue containing nonferrous metals	r 16,131	13,568	Mainly to United States.
Oxides, hydroxides, peroxides of metals	r 64,980	59,134	Do.
Metals:			
Base metals including alloys, all forms	r 1,655	1,339	United States 663; Japan 168.
Precious metals [6]—troy ounces	r 54,597	58,655	United States 49,613; United Kingdom 6,884.
NONMETALS			
Abrasives:			
Natural	r 368	222	Mainly to United States.
Fused alumina, crude and grains	r 184,216	127,455	Do.
Silicon carbide, crude and grains	r 91,973	78,824	Do.
Grinding and polishing wheels and stones—value, thousands	r $1,014	$1,020	Do.
Asbestos:			
Crude	r 582	183	United States 93; United Kingdom 49; Japan 41.
Milled fiber, all grades—thousand tons	1,652	1,074	United States 458; West Germany 120.
Barite, crude	r 31,263	45,606	Mainly to United States.
Cement, portland—thousand tons	1,148	997	Do.
Clays and clay products (including all refractory brick):			
Crude clays, including refractory clay—do	r 1,095	553	Do.
Products:			
Refractory (including nonclay bricks)—value, thousands	r $13,588	$15,183	Do.
Nonrefractory—do	r $2,247	$1,655	Do.

See footnotes at end of table.

Table 3.—Canada: Exports and reexports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974 [1]	1975	Principal destinations, 1975
NONMETALS—Continued			
Diamond:			
Gem ---------- carats	27,398	26,810	Belgium-Luxembourg 7,775; Netherlands 6,450; United States 5,427.
Industrial (including dust) ---------- do	711,679	450,054	United States 234,910; Belgium-Luxembourg 82,428.
Fertilizer materials:			
Nitrogenous ---------- thousand tons	r 620	502	Mainly to United States.
Potassic ---------- do	9,044	7,242	Do.
Mixed ---------- do	r 724	532	Do.
Ammonia ---------- do	96	116	Do.
Gypsum, crude ---------- do	5,212	3,692	Do.
Lime ----------	r 386,653	235,779	Do.
Nepheline syenite ----------	454,699	356,086	Do.
Pigments, mineral, including processed iron oxides ----------	r 14,843	9,824	United States 8,000; Poland 1,086.
Precious and semiprecious stones, except diamond ---------- value, thousands	r $1,743	$2,382	United States $397; Hong Kong $349; West Germany $336.
Salt and brines ---------- do	r $7,021	$5,111	Mainly to United States.
Sand and gravel ---------- thousand tons	r 358	138	Do.
Sodium sulfate ----------	r 236,971	178,109	Do.
Stone:			
Limestone, crude, crushed, refuse thousand tons	1,219	1,218	Do.
Quartzite ---------- do	144	40	All to United States.
Rough building and crude, n.e.s -- do	r 482	303	Mainly to United States.
Sulfur:			
Crude and refined ---------- do	r 4,252	3,284	United States 975; Italy 339.
Sulfuric acid and oleum ---------- do	249	225	Mainly to United States.
Talc, steatite, soapstone, pyrophyllite [3] -----	r 9,354	6,065	All to United States.
Other nonmetals, crude --- value, thousands	r $44,826	$44,913	United States $13,747; West Germany $8,400; France $5,433.
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous ---------- thousand tons	r 10,833	11,695	Mainly to Japan.
Coke from coal ----------	r 261,167	99,998	United States 68,968; Netherlands 15,639; Spain 15,391.
Fuel briquets, coal and coke ----------	37,858	2,220	Mainly to United States.
Gas, natural ---------- million cubic feet	960,713	949,465	All to United States.
Peat ----------	275,270	263,372	Mainly to United States.
Petroleum:			
Crude ------ thousand 42-gallon barrels	r 333,921	262,455	Do.
Refinery products:			
Gasoline ---------- do	1,672	4,876	United States 3,708; Mexico 780.
Distillate fuel oil ---------- do	r 5,189	6,597	Netherlands 2,954; United States 2,094.
Residual fuel oil ---------- do	r 32,274	21,111	Mainly to United States.
Lubricants ---------- do	r 43	16	United States 8.
Other:			
Liquefied petroleum gas -- do	r 32,286	36,919	Mainly to United States.
Asphalt ---------- do	r 637	331	Do.
Petroleum coke and pitch coke do	r 153	980	United States 668; United Kingdom 159.
Total ---------- do	r 72,254	70,830	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals -------- do	r 444	284	Mainly to United States.

r Revised.

[1] Many figures for 1974 are revised from those appearing in the previous edition of this chapter owing to the inclusion of reexports.

[2] May include relatively minor quantities of certain shapes not normally included among semimanufactures.

[3] Partial figures; data given are U.S. imports for consumption only.

[4] Includes some scrap.

[5] Largely, if not all, used in the production of heavy aggregate.

[6] Excludes scrap and sweepings valued in thousands at r $22,283 in 1974 and $26,410 in 1975.

Table 4.—Canada: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite ---thousand tons--	2,716	2,421	Guinea 1,142; Guyana 821; Sierra Leone 333.
Alumina ---do---	884	761	Australia 404; United States 212; Jamaica 79.
Metal including alloys:			
Scrap	5,836	7,011	Mainly from United States.
Unwrought	r 959,001	366,051	United States 216,470; United Kingdom 65,045.
Semimanufactures (including cable)	r 208,696	135,490	Mainly from United States.
Antimony oxides	796	395	Mainly from United Kingdom.
Chromium:			
Ore and concentrate, Cr content	28,776	29,663	United States 13,071; Philippines 9,579; Cyprus 4,229.
Oxide and hydroxide	1,414	956	United States 760; France 108.
Copper:			
Ore and concentrate (including scrap), Cu content	54,329	20,247	Mainly from United States.
Copper sulfate	521	807	Belgium-Luxembourg 430; Netherlands 224.
Metal:			
Unalloyed:			
Unwrought	22,106	10,908	United States 6,343; Chile 2,858.
Semimanufactures	5,632	5,435	United States 4,025; Japan 580.
Alloys, unwrought and semimanufactures (including cable)[1]	17,467	13,131	United States 9,039; United Kingdom 1,743.
Iron and steel:			
Iron ore ---thousand tons--	2,333	4,844	United States 3,980; Brazil 690.
Scrap ---do---	767	929	Mainly from United States.
Pig iron and related materials	17,194	11,941	Do.
Ferroalloys:			
Ferrochrome	38,392	41,109	Republic of South Africa 20,174; Brazil 12,980; United States 4,824.
Ferromanganese (includes spiegeleisen)	17,114	35,701	United States 18,706; Norway 5,173; Republic of South Africa 5,087.
Silicomanganese (includes silico spiegeleisen)	r 542	5,732	All from United States.
Ferrosilicon	10,560	26,353	United States 19,172; Yugoslavia 3,769.
Ferrotungsten	186	45	United Kingdom 38; United States 7.
Ferrovanadium	370	100	All from United States.
Other	17,699	8,880	Dominican Republic 4,746; United States 2,755.
Steel, primary forms	47,804	106,572	United States 69,176; France 20,204.
Semimanufactures:			
Bars, rods, angles, shapes, sections:			
Wire rod	295,766	236,645	France 81,930; Japan 70,838; Czechoslovakia 52,042.
Other bars and rods[1]	478,950	146,345	United States 81,995; Japan 19,145.
Angles, shapes, sections	594,210	190,655	United States 103,950.
Universals, plates, sheets, strip	1,323,172	582,573	United States 231,772; Japan 146,221; West Germany 60,052.
Rails and accessories	34,570	67,531	Mainly from United States.
Wire	78,741	54,041	United Kingdom 18,522; Japan 8,211; West Germany 7,467.
Tubes, pipes, fittings	250,206	196,138	United States 92,821; Japan 56,451.
Castings and forgings	134,370	108,826	United States 88,166; United Kingdom 10,686.
Lead:			
Oxide	5,312	1,002	Mexico 681; United States 273.
Metal including alloys, unwrought and semimanufactures[1]	12,059	2,434	Mainly from United States.
Magnesium metal including alloys	7,484	8,386	United States 6,058; Netherlands 1,298.

See footnotes at end of table.

Table 4.—Canada: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Manganese:			
Ore and concentrate, Mn content	125,103	69,773	Gabon 37,526; Brazil 15,532; United States 9,345.
Metal	3,935	5,390	Mainly from Republic of South Africa.
Mercury ——76-pound flasks	3,157	2,133	United States 1,405; Netherlands 622.
Molybdenum, molybdic oxide, gross weight	86	56	All from United States.
Nickel:			
Ore and concentrate (including scrap), Ni content	10,677	17,894	Australia 8,678; United States 5,813; United Kingdom 2,133.
Metal including alloys:			
Unwrought	15,234	12,847	All from Norway.
Semimanufactures [1]	6,423	4,738	Mainly from West Germany.
Platinum-group metals ——troy ounces	49,124	60,971	Mainly from United States.
Silver metal ——thousand troy ounces	29,246	13,506	Do.
Sodium metal	9,199	8,289	Do.
Tin metal, unwrought and semimanufactures [1]	5,668	4,680	Malaysia 1,636; United States 1,360; Australia 483.
Titanium:			
Dioxide, pure and extended	r 4,310	2,708	United States 1,882; United Kingdom 606.
Metal	416	405	Mainly from United States.
Tungsten ore and concentrate, W content	--	1	All from United States.
Zinc:			
Ore and concentrate (including scrap), Zn content	2,125	756	Mainly from United States.
Oxide and peroxide	2,290	1,479	United States 1,123; Mexico 215.
Metal:			
Blue powder	250	116	United States 86; United Kingdom 30.
Unwrought	7,021	686	United States 472; Japan 100; Singapore 90.
Semimanufactures [1]	3,292	1,095	Mainly from United States.
Zirconium metal alloys	223	222	Do.
Other:			
Ores and concentrates (including scrap), gross weight	101,388	85,935	United States 47,608; Peru 13,330; Australia 13,046.
Oxides, hydroxides, peroxides of metals	4,973	4,471	Mainly from United States.
Base metals including alloys, all forms	2,692	1,625	United States 772; Finland 272; Norway 264.
Precious metals [1] ——troy ounces	70,198	45,235	Mainly from United States.
NONMETALS			
Abrasives:			
Natural	13,106	16,094	All from United States.
Grinding and polishing wheels and stones ——value, thousands	r $8,355	$8,196	Mainly from United States.
Asbestos	3,932	5,166	Republic of South Africa 3,817; United States 1,348.
Barite, crude	11,678	4,479	All from United States.
Cement	262,444	428,777	Mainly from United States.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Bentonite	263,529	242,183	United States 183,913; Greece 58,269.
Fire clay	44,707	43,320	All from United States.
Fuller's earth	8,606	1,838	Do.
Kaolin (china clay)	181,260	148,378	United States 102,694; United Kingdom 45,675.
Other (including refractory clay)	108,403	143,156	Mainly from United States.
Products:			
Refractory (including nonclay bricks) ——value, thousands	r $55,278	$62,119	Do.
Nonrefractory ——do	r $27,731	$25,025	Italy $7,030; United States $4,773; Japan $4,395.
Cryolite, crude	8,890	2,219	Denmark 1,731; People's Republic of China 454.

See footnotes at end of table.

Table 4.—Canada: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Diamond:			
Gem, not set or strung ---carats--	128,872	157,978	Israel 51,487; Belgium-Luxembourg 49,885; Republic of South Africa 18,771.
Industrial ---do---	1,126,199	1,032,396	United States 657,024; Ireland 167,879; Republic of South Africa 114,876.
Dust and powder ---do---	611,639	489,830	Mainly from United States.
Diatomite	29,098	30,270	All from United States.
Fertilizer materials:			
Nitrogenous	62,344	88,383	United States 57,237; Netherlands 15,063.
Phosphatic:			
Phosphate rock --thousand tons--	3,366	3,282	Mainly from United States.
Other	93,026	128,045	Do.
Potassic	51,637	44,458	All from United States.
Other including mixed	75,861	96,983	United States 80,097; France 16,468.
Fluorspar	142,246	157,222	Mexico 85,306; Spain 42,258; United States 18,693.
Gypsum	56,251	55,338	Mexico 39,100; United States 16,179.
Iodine	282	167	Japan 145; United States 19.
Lime	21,024	30,099	Mainly from United States.
Magnesium:			
Dolomite, calcined	3,108	2,239	All from United States.
Deadburned or sintered	45,412	84,481	United States 48,918; Greece 20,699.
Other	2,300	3,081	All from United States.
Mica, crude	4,876	5,111	Mainly from United States.
Pigments, mineral, including processed iron oxides	8,185	5,548	Do.
Precious and semiprecious stones, except diamond ---value, thousands--	r $8,902	$8,707	United States $2,603.
Salt and brine	736,573	1,183,144	United States 934,725; Mexico 165,042.
Sodium carbonate (including sal soda)	201,364	141,175	Mainly from United States.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	128,522	202,716	Mainly from United States.
Caustic potash, sodic and potassic peroxides	2,062	5,961	Do.
Sodium sulfate (Glauber's salt)	22,519	22,638	United Kingdom 7,754; Belgium-Luxembourg 7,690; United States 7,191.
Stone, sand and gravel:			
Stone:			
Dimension:			
Crude and partly worked	35,402	53,380	Mainly from United States.
Worked ---value, thousands--	$4,529	$5,793	United States $2,588; Italy $2,515.
Limestone ---thousand tons--	2,525	3,282	Mainly from United States.
Pumice and lava	3,916	28,563	Greece 15,242; United States 13,206.
Quartz, silex and crystallized	1,671	1,550	Mainly from United States.
Other including crushed and broken	92,985	86,651	Do.
Sand and gravel:			
Silica sand ---thousand tons--	956	1,044	All from United States.
Other ---do---	1,573	1,910	Do.
Sulfur:			
Elemental	31,389	14,335	Do.
Sulfuric acid (including oleum)	124,739	154,020	United States 78,825; Sweden 61,031.
Talc, steatite, soapstone, pyrophyllite	36,248	30,428	Mainly from United States.
Vermiculite, crude	44,738	55,617	United States 40,935; Republic of South Africa 14,682.
Other nonmetals, n.e.s.:			
Crude ---value, thousands--	r $4,043	$3,310	Mainly from United States.
Oxides and hydroxides of magnesium, strontium, barium	60,623	32,997	Do.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s --value, thousands--	$9,221	$8,569	United States $6,151; United Kingdom $1,895.

See footnotes at end of table.

Table 4.—Canada: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural value, thousands	r $606	$674	Mainly from United States.
Carbon black	7,104	7,009	Do.
Coal, all grades thousand tons	12,381	15,255	Do.
Coke from coal do	509	546	Do.
Fuel briquets, coal and coke	18,819	16,636	All from United States.
Gas, natural million cubic feet	9,228	10,447	Do.
Hydrogen and other rare gases	9,122	25,319	Mainly from United States.
Petroleum:			
Crude thousand 42-gallon barrels	291,120	298,572	Venezuela 93,520; Saudi Arabia 69,160; Iran 68,872.
Refinery products:			
Gasoline:			
Aviation do	31	19	United States 13; Netherlands Antilles 6.
Motor do	31	198	Netherlands 169; Netherlands Antilles 29.
Kerosine do	1	2	Mainly from United States.
Jet fuel do	1,839	578	Netherlands Antilles 321; United States 187; Netherlands 70.
Distillate fuel oil do	3,406	2,177	Netherlands Antilles 1,203; Bahamas 350; Venezuela 225.
Residual fuel oil do	19,240	6,822	Venezuela 4,148; United States 944; Trinidad and Tobago 600.
Lubricants (including grease) do	1,709	1,302	United States 1,058; Trinidad and Tobago 167.
Other:			
Liquefied petroleum gas do	73	64	Mainly from United States.
Naphtha do	104	82	All from United States.
Asphalt and road oils do	45	168	United States 78; Venezuela 46; Netherlands Antilles 34.
Petroleum and pitch coke do	4,103	3,149	Mainly from United States.
Petroleum jelly and wax do	72	63	Do.
Unspecified do	1,097	868	Do.
Total do	31,751	15,482	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	119,322	119,442	United States 78,512; United Kingdom 21,677.

r Revised.
1 May include relatively minor quantities of certain shapes not normally included among semimanufactures.

COMMODITY REVIEW

METALS

Aluminum.—The economic recovery during 1976 that induced other world aluminum producers to increase output was not reflected in Canada's aluminum industry. Both alumina and aluminum metal output, obtained from ore imported primarily from Guinea, Guyana, Sierra Leone, and Surinam, were significantly below the 1975 totals. Largely because of strikes, total smelter production by the Aluminum Co. of Canada Ltd. (Alcan) declined to 543,000 tons in 1976 from 838,000 tons in 1975, according to the company's annual report. Strikes, which started in June, stopped production at three of Alcan's Quebec smelters for almost 6 months. Production was resumed in November, but full output was not expected to be reached before yearend. Canadian Reynolds Metals Co. Ltd., which operated a smelter at Baie Comeau, Quebec, produced 157,800 tons, up from the 148,800 tons produced in 1975. Reynolds imported most of its alumina from the United States.

Because of more favorable economic conditions worldwide in 1976, expansion programs by Alcan and Reynolds were resumed. Expansions in ingot capacity of 25,000 tons each were nearing completion

at Arvida, Quebec, and Kitimat, British Columbia. Alcan planned a 30-year expansion program estimated to cost about $1 billion. In the first phase of the expansion, plans called for construction of a new 190,000-ton-per-year smelter at Port Alfred, Quebec. The plant would be built in three 63,000-ton modules, each estimated to cost $150 million. Following completion of the smelter, plans called for 100,000 tons of additional annual capacity through modernization of existing smelters in Quebec, which now have a total annual installed capacity of 735,000 tons. Eventually, capacity would also be increased at the Kitimat smelter in British Columbia. No definite timetable was announced for initial construction of these projects because of uncertainty over sources of financing. However, part of the new capacity was expected to come onstream by about 1980. Expansion of 135,000 tons per year by Reynolds at its Baie Comeau smelter in Quebec was on schedule.

Reynolds completed a 145,000-square-foot addition to its Cap-de-la-Madeleine, Quebec, rolling mill to house additional melting, casting, and other manufacturing equipment. Alcan was in the final stages of installing a second cold-rolling mill and a continuous heat-treating line at its Kingston, Ontario, works. The $22 million installation would increase Alcan's coiled sheet capacity to 190,000 tons per year.

Copper.—Mine output from 70 Canadian mining operations increased 2% over that of 1975. Smelter production was also above the previous year's level, but refinery output declined. Mine output was higher in all major provinces except Manitoba. British Columbia remained the leading copper-producing province with 37% of the total, followed by Ontario with 35%, Quebec with 16%, Manitoba with 8%, and the remaining provinces with 4%. The increased mine output was attributed to a partial recovery of copper consumption in Japan and to redirecting part of the flow of copper concentrate production to North American smelters.

In British Columbia, Brenda Mines Ltd. set new company production records in 1976. Operating a porphyry copper-molybdenum mine containing ore averaging 0.188% copper and 0.052% molybdenum, Brenda Mines increased copper-in-concentrates production 5% over that of 1975. The improvement in operating performance was due to full computer control of all grinding and flotation units in the concentrator.

Placer Development Ltd. (33% owned by Noranda Mines Ltd) operated the Craigmont mine in Merritt, British Columbia, and the Gibraltar mine in McLeese Lake, British Columbia, during the year. The Gibraltar mine, affected by a 5-month strike, milled 5 million tons of ore grading 0.43% copper. Its production of copper in concentrate was reduced 40% to 17,000 tons. Reserves decreased to 308 million tons with an average grade of 0.35% copper. At

Table 5.—Canada: Aluminum production facilities in 1976

Company	Plant location	Products	Rated annual capacity (thousand metric tons)
Aluminum Co. of Canada Ltd.	Arvida, Quebec	Sized bauxite, calcined alumina, primary aluminum and alloy ingots, super-purity aluminum.	[1] 1,664
Do	Beauharnois, Quebec	Primary aluminum and alloy ingots.	47
Do	Shawinigan, Quebec	----do	83
Do	Isle-Maligne (Alma), Quebec.	----do	100
Do	Kitimat, British Columbia	----do	271
Canadian Reynolds Metals Co. Ltd.	Baie Comeau, Quebec	Primary aluminum and alloy ingots, extrusion billets, rolling blocks, wire bars.	158

[1] 1,258,000 tons alumina and 406,000 tons aluminum.

Source: Department of Energy, Mines and Resources, Ottawa.

Craigmont, 2.2 million tons of ore grading 1.42% copper was milled. The 95,000 tons of concentrates produced contained 29,000 tons of copper, an increase of 7% over that of 1975. Ore reserves of 7 million tons with 1.83% copper were sufficient to maintain operations at the 1976 level for 3 to 4 years.

Copper production by Lornex Mining Corp. Ltd. was 37% higher than that of 1975. Changes in a Lornex sales agreement to Japanese copper concentrate buyers were the principal factors in the company's increased output. The modified sales agreement provided for deliveries of fixed amounts of copper concentrates in the years 1976–79 rather than the full production of the mine. Lornex also agreed to a temporary upward adjustment in refining charges for its Japanese buyers.

Afton Mines Ltd., controlled 54% by Teck Corp. Ltd., continued work on its mine-smelter complex. The $800 million operation was expected to have a capacity of 25,000 tons of copper per year when completed in 1977. This would be the first copper smelter to employ the New Top Brown Rotary Converter process developed by the International Nickel Co. of Canada Ltd. (INCO) and Dravo Corp. The complex syenite porphyry deposit contains 34 million tons of open pit ore grading 1% copper. As an incentive to encourage the construction of copper smelters in the Province, the British Columbian government would provide Afton with payment of $0.02 per pound of copper produced from the smelter during its first 4 years of operation. The Province also had an option to purchase, at cost, a 5% joint venture interest in the smelter unit, exercisable for a period of 1 year after completion of the project.

Bethlehem Copper Corp. Ltd. milled 7.5 million tons of ore grading 0.47% copper from open pit mines in the Highland Valley and produced concentrates containing 25,000 tons of copper compared with 27,300 tons in 1975. Reserves at the operating Huestis, Iona, and Jersey mines totaled 56 million tons of 0.46% copper. Utah International Inc. shipped approximately 45,350 tons of copper from its copper mine on the northern end of Vancouver Island in British Columbia. The mill treated 15 million tons of ore in 1976.

In Ontario, Union Minière Explorations and Mining Corp. Ltd. (UMEX) began operations at its new Thierry copper deposit in the Pickle Crow area of Ontario in August. Concentrates were shipped to Noranda, Quebec, for smelting, and refining was done at Noranda Mines' Montreal refinery. The complete cost of the project was $104 million. Ore reserves were estimated to be 15 million tons, with an average grade of 1.63% copper. This was considered adequate for at least 12 years of operation at the planned production rate of 1.3 million tons of ore per year. Production for the first year was to be from two small open pit mines, followed by production from an underground mine.

Production of copper by Falconbridge Nickel Mines Ltd. in the Sudbury area of Ontario was 60,445 tons, 2% above the 59,300-ton total for 1975. Concentrates from the copper-nickel operations were processed at the company's smelter in Sudbury and from the other copper-zinc operations at the Noranda Mines smelter at Noranda, Ontario. The Falconbridge smelter modernization program, which was temporarily suspended in 1975, was resumed in late 1976. The project was estimated to cost $97 million.

At the Kidd Creek mine of Texasgulf Canada Ltd. in the Timmins District, production continued at both open pit and underground mines. Production was about 63% from open pit operations and 37% from underground operations. The mine yielded 212,920 tons of 25% copper concentrate and 430,194 tons of copper-silver-zinc concentrate during 1976. At yearend 1976, measured and indicated reserves were estimated at 83 million tons averaging 2.7% copper. An additional 6 million tons was classified as inferred reserves. Texasgulf Canada proceeded with a $100 million project to increase the mine production rate from 3.3 million tons to 4.5 million tons per year by adding a fourth 3,500-ton-per-day circuit to the concentrator and by construction of a 1,600-meter shaft to develop the lower portion of the ore body.

INCO mined 19.8 million tons of ore with an average grade of 0.97% copper from mines in Ontario, compared with 21.2 million tons of ore with an average grade of 0.92% copper in 1975. Deliveries

of copper metal from the Copper Cliff refinery increased 6% to 177,200 tons in 1976, but were about 5,000 tons below the record 1974 figure. At yearend, INCO had proven ore reserves in Canada of 412 million tons, containing 1.06% copper.

In northwestern Ontario, Mattagami Lake Mines Ltd. reported that development work on its Lyon Lake mine was on schedule. A three-compartment shaft was sunk during the year. Commercial production of 1,000 tons of ore per day was scheduled for 1978. Reserves at the Lyon Lake deposit were increased to 4 million tons of ore grading 1.2% copper. The Geco mine of Noranda Mines in Manitouwadge, Ontario, produced 2 million tons of ore averaging 1.8% copper.

In Quebec, Campbell Chibougamau Mines Ltd. resumed operations in July 1976. These mines were closed in May 1975 because of low copper prices and failure to reach agreement on the terms of a new labor contract. Because of depressed copper prices, the Sullivan Mining Group Ltd. also announced its intention to close its operations at Cupra and D'Estrie in the eastern townships of Quebec.

Noranda treated 45 million tons of ore containing 210,100 tons of copper from 19 copper and zinc-copper mines in Quebec, British Columbia, Ontario, and New Brunswick. The company's two copper smelters, at Noranda, Quebec, and Gaspé Copper Mines Ltd. in Murdochville, Quebec, treated 870,000 tons of concentrates from Noranda operations and 825,000 tons of custom material from other Canadian copper mines and from overseas. The 1.7 million tons of total concentrates yielded 301,200 tons of copper in anodes, a decrease of 9% from that of 1975. Canadian Copper Refiners Ltd. (CCR) in Montreal East, Quebec, operated by Noranda, is one of the word's largest copper refineries with a rated annual capacity of 432,000 tons. In 1976, refinery production decreased 7% to 395,000 tons of copper. CCR processed the output of Noranda smelters, the Flin Flon smelter of Hudson Bay Mining & Smelting Co. Ltd., and also imported and secondary sources.

In Manitoba, Hudson Bay Mining & Smelting operated eight mines and one smelter in the Flin Flon Lake area. Approximately 1.4 million tons of ore with an average grade of 2.4% copper was processed to produce 195,000 tons of a 16% concentrate containing 32,000 tons of copper, a decrease of 2% from that of 1975. The copper smelter produced 64,360 tons of anode copper from feed supplied 48% by Hudson Bay mines and 52% by purchased concentrates. Development work continued on the new Centennial and Westarm mines. A 500-meter shaft was completed at the Westarm mine during 1976, and some surface facilities were installed. The main shaft at Centennial was sunk to a depth of 420 meters and lateral development was started on most levels. The Schist Lake and White Lake mines were closed in 1976 owing to exhaustion of economic ore reserves. At yearend, Hudson Bay had reserves of 16 million tons grading 2.8% copper.

Sherritt Gordon Mines Ltd. operated the Fox, Lynn Lake, and Ruttan mines and produced a combined output of 37,919 tons of copper in concentrate compared with 43,400 tons in 1975. Production declined at all three mines. At Ruttan the tonnage of ore mined and milled in 1976 was 95% of the planned rate of production but only 80% of the 1975 tonnage. Low availability of pit equipment and the increasing hauling distance continued to limit production. Operations at the Fox mine were reduced to a 5-day week in March 1976, to preserve resources. Tonnage of ore milled declined 17% from that of 1975, and the average copper grade was lower, resulting from temporary production problems in the higher grade stopes. The Lynn Lake mine was closed in June 1976. The use of a mining contractor provided evidence that the mine was no longer economical. The net operating loss and shutdown cost in 1976 totaled $3.3 million.

Sherritt Gordon successfully completed a pilot plant test of a new hydrometallurgical copper recovery process at the Fort Saskatchewan metallurgical complex. The process was a joint venture between Sherritt Gordon and Cominco Ltd. with 50% funding by the Federal Government. This environmentally clean process was applicable to a wide range of copper sulfate concentrates and produced high-purity copper by electrowinning, and sulfur as a by-product in elemental form. Secondary values also associated with copper concen-

Table 6.—Canada: Copper smelters and refineries in 1976

Company	Plant location	Products	Annual capacity (thousand metric tons)
Canadian Copper Refiners Ltd.	Montreal East, Quebec	Electrolytic wirebars, ingot bars, ingots, cathodes, cakes, billets.	435
		Copper sulfate	12
Falconbridge Nickel Mines Ltd.	Falconbridge, Ontario.	Copper-nickel matte	[1] 590
Gaspé Copper Mines Ltd	Murdochville, Quebec	Anodes	[1] 336
Hudson Bay Mining & Smelting Co. Ltd.	Flin Flon, Manitoba	Blister	[1] 522
International Nickel Co. of Canada Ltd.	Copper Cliff, Ontario	Blister, cathodes, wirebars, cakes, billets.	[2] 192
Noranda Mines Ltd	Noranda, Quebec	Anodes	[3] 1,542

[1] Ore and concentrate.
[2] Blister or refined.
[3] Ore, concentrate, and scrap.

Source: Department of Energy, Mines and Resources, Ottawa.

trate, such as gold, silver, zinc, and molybdenum, were also recovered.

Gold.—Reversing the downward trend of the past decade, Canada's gold production increased about 2% in 1976, although value of output was lower. The sharp drop in the price of gold reduced the dollar value of Canadian output by 25%. The price was $132 per troy ounce in January 1976, receded to $110 in August, and averaged $123 for the year. This decline caused some serious financial problems, especially for marginal gold mines. In order to operate at a profit or at reduced losses, the marginal mines were forced to reduce labor forces, curtail development, and mine higher grade ores. Mine operators also approached the Government for financial assistance to enable the mines to operate until the price of gold improved.

The Emergency Gold Mining Assistance Act (EGMA) expired on June 30, 1976. The Act, which came into force in 1948, provided financial assistance to marginal gold mines to counteract the effect of increasing costs of production and the fixed price of gold. By enabling gold mines to extend their productive lives, the subsidy helped communities dependent on gold mining to adjust gradually to diminishing economic support. The amount paid to gold mine operators during the life of EGMA totaled $303,104,402 for 61,813,545 troy ounces of gold produced and sold in accordance with the requirements of EGMA.

At yearend, there were 22 operating gold mines, accounting for about 73% of total gold production. Two new mines opened in 1976, and several of the smaller base metal mines that produce gold as a byproduct closed.

Although its output was approximately 3% below the 1975 level, Ontario remained the largest gold-producing province, accounting for 44% of the total output. Campbell Red Lake Mines Ltd., the largest gold producer in Canada, operated continuously throughout the year. Located in the district of Balmertown, Ontario, the mill treated over 800 tons of ore per day. Routine development work continued to disclose sufficient ore to maintain ore reserves. Increased costs of labor and supplies and a sharp reduction in the price of gold forced Bulora Corp. Ltd. to close its Red Lake District gold mine, formerly the property of Madsen Red Lake Gold Mines Ltd. Hollinger Mines Ltd. sold its Ross properties at Holtyre and Timmins to Pamour Porcupine Mines Ltd. The ore from the Ross mine was trucked to Timmins for treatment. Pamour operated four mines in the Timmins area. Increasing costs of labor, supplies, and services and the low gold price placed the mines in serious financial difficulties. To offset these adverse factors, the company was forced to reduce its labor force and to phase out lower grade and higher cost ore blocks. Rengold Mines Ltd. brought its 270-ton-per-day gold property, the formerly producing Renabie gold mine near Missanabie, into production in January but was forced to close the mine in June because of finan-

cial problems and the drop in the gold price.

Virtually all gold produced in Alberta, Manitoba, Saskatchewan, and British Columbia was recovered as a byproduct of base metal mining. Northair Mines Ltd. began production at its 270-ton-per-day concentrator located near Brandywine Falls, about 110 kilometers north of Vancouver, British Columbia, in March 1976. This is a vein-type deposit, and reserves were estimated at 410,000 tons averaging 13 grams of gold per ton of ore, 9 grams of silver per ton, and 5.4% combined lead and zinc. Dusty Mac Mines Ltd. exhausted its reserves and closed in May. Small quantities of placer gold were recovered from deposits in the north-central part of the Province and in the Atlin District.

In the Yukon Territory, the older placer districts attracted considerable attention. Claymore Resources Ltd. carried out an extensive program testing ground in the recently discovered placer deposits in the Ladue River District on the Alaska-Yukon boundary, about 48 kilometers north of the Alaska Highway. Other properties in the area were also receiving attention.

Iron Ore.—Canada's iron ore industry performed well in 1976 owing to increased capacity, new demand, and additional mining operations. Ore shipments were 22% higher than those of 1975. The increase in production was due mainly to improvements in the operations of Wabush Mines and the Iron Ore Company of Canada (IOC), and new production from the Mount Wright operation in Quebec, owned by Quebec Cartier Mining Co. (QCM). Canada's iron ore industry was primarily export oriented, with 79% of production entering international markets in 1976. Exports were expected to increase further in 1978 when the Mount Wright operation reaches full production capacity of 18 million to 20 million tons per year. Imports decreased from 4.8 million tons in 1975 to an estimated 3.1 million tons in 1976. The decrease was attributed to greater output from Wabush Mines in which the

Table 7.—Canada: Precious metal smelters and refineries in 1976

Company	Plant location	Products	Annual capacity (thousand metric tons)
Brunswick Mining & Smelting Corp. Ltd.	Belledune, New Brunswick.	Silver bullion (fire-refined).	2,500
Canadian Copper Refiners Ltd.	Montreal East, Quebec	Electrolytic fine gold and silver, gold bars.	[1] 720 [2] 25,000
Cominco Ltd	Trail, British Columbia	High-purity gold and silver, silver bars.	[2] 12,000
Engelhard Industries of Canada Ltd.	Toronto, Ontario	Refined gold, silver, and platinum-group metals.	NA
Handy & Harman of Canada Ltd.	----do	Refined gold, silver, and platinum-group metals, gold and silver sheet and wire, alloys and solders.	NA
Hudson Bay Mining & Smelting Co. Ltd.	Flin Flon, Manitoba	Gold and silver in copper anodes.	[1] 75 [2] 1,000
International Nickel Co. of Canada Ltd.	Copper Cliff, Ontario	Fine gold and silver, platinum-group metals in concentrates.	NA
Johnson, Matthey & Mallory Ltd.	Toronto, Ontario	Refined gold, silver, and platinum-group metals and alloys in various forms.	NA
Royal Canadian Mint	Ottawa, Ontario; Hull, Quebec.	Refined gold and silver, coinage.	7,000

NA Not available.
[1] Gold.
[2] Silver.

Source: Department of Energy, Mines and Resources, Ottawa.

Steel Co. of Canada Ltd. (Stelco) and Dominion Foundries and Steel Ltd. (Dofasco) had interests. Imports, however, were expected to increase substantially in later years, and could exceed 7 million tons per year by 1980, probably from Cleveland-Cliffs Iron Co.'s Tilden mine in Michigan and the Eveleth Taconite Co. and Hibbing Taconite Co. in Minnesota.

There were 15 iron ore producers in Canada during 1976, but IOC and QCM accounted for approximately 69% of the total output for the year. IOC produced about 21 million tons alone, representing 37% of Canada's output. IOC completed a major 3-year expansion program, increasing combined annual production capacity at Schefferville and Labrador City, Labrador, and Sept-Iles, Quebec, to about 31 million tons. At Labrador City, the existing pellet plant was reconstructed and an 11-million-ton-per-year concentrator expansion was initiated to increase concentrate production to about 21 million tons annually. At Sept-Iles, a 6-million-ton-per-year pellet plant was installed to upgrade ore from Schefferville.

At QCM, development work on two major projects, Fire Lake and Mount Wright, both in Quebec, was near completion. The Mount Wright project included development of a new mine, a new beneficiation complex, and the new town of Fermont, Quebec. The operation will have a capacity of over 18 million tons of concentrate per year by mid-1977. QCM completed the restructuring of its Fire Lake project. Sidbec-Dosco Ltd., the Quebec Provincial steel company, purchased the Fire Lake iron ore mine and the Lac Jeannine beneficiation facilities and began building a pellet plant. The project included the development of the Fire Lake mine, the purchase and redesign of the Lac Jeannine concentrator at Gagnon, Quebec, and the construction of a 6-million-ton-per-year pellet plant at Port Cartier, Quebec. Of two beneficiating and pelletizing lines, each with 3 million tons of capacity, one line was designed to produce a standard blast furnace pellet grading about 65.5% iron, and the other was designed to produce a special high-grade pellet grading 68% iron for use as feed material in Sidbec's direct reduction plant at Contrecoeur, Quebec.

Campbell Chibougamau requested the Marcona Corp. to prepare a preliminary market study for the production of pellets. Campbell Chibougamau delineated some 300 million tons of magnetite ore and expected to produce 4 million tons of pellets annually for use in direct reduction plants. The pellets would contain 66% iron, 2.5% silica, and 1% titanium. Hilton Mines Ltd. was expected to cease operation at its iron ore mine near Shawville, Quebec, in mid-1977 when its ore reserves are depleted.

In Ontario, the direct reduction plant of Stelco at the Griffith mine operated from January to mid-March when the plant closed because of operating problems. While in production, the plant operated at 75% capacity and produced 300,000 tons of sponge iron. It was expected to reopen in 1977 and operate at about 50% capacity. The plant had a rated capacity of 400,000 tons of sponge iron per year.

The direct reduction plant of Sudbury Metals at Falconbridge, Ontario, owned by Allis-Chalmers Corp. and National Steel Corp. of Canada Ltd., opened in May. Annual capacity was 275,000 tons of sponge iron. The plant uses INCO oxide pellets as feed material and oil and gas as a reductant and could eventually use solid reductants.

Iron and Steel.—Canada began recovering from the economic recession of 1975, but the steel industry experienced an unfavorable year in the face of low demand for steel products. Crude steel production was slightly above the 1975 level. Domestic consumption of 9.6 million tons was 4% below the 1975 level, but producer shipments increased from 9.5 million tons in 1975 to 9.8 million tons in 1976, owing to increased exports to the United States. The steel industry was relatively free of labor strikes, although strikes did occur at several plants. Steel prices increased about 4% to 10% in 1976, reflecting cost increases for labor, energy, raw materials, and transportation.

Despite the drop in consumption, the steel industry initiated major expansion programs. The most significant was by Stelco, Canada's largest steel company, with its commitment to a new steel complex at Nanticoke, Ontario. Initial steel production capacity, scheduled for completion in 1980, will be 1.2 million tons

Table 8.—Canada: Iron ore mining and processing facilities in 1976 [1]

Province	Operating company	Location	Products	Mill capacity (thousand metric tons)	Remarks
Newfoundland and Labrador.	Iron Ore Company of Canada.	Carol Lake, Labrador City.	Concentrate, pellets	127 (ore per day)	Open pit mine; annual capacity of 10 million tons concentrate, 9 million tons pellets.
Do	----do	Schefferville (Labrador).	Direct-shipment ore	60 (ore per day) (including New Quebec production).	Open pit mine; ore from five open pits shipped to Sept-Iles for shipment and pelletizing.
Do	Pickands Mather & Co	Scully mine, Wabush	Concentrate	17 (concentrate per day).	Open pit mine; shipment to Pointe Noire for pelletizing. Seven participating companies; operating company is managing agent.
Quebec	Hilton Mines Ltd	Shawville, Bristol Township.	Pellets	6.2 (ore per day)	Open pit mine; 900,000 tons shipped annually.
Do	Iron Ore Company of Canada.	Schefferville (Quebec)	[2]	[2]	[2]
Do	----do	Sept-Iles	Pellets	22 (ore per day)	Beneficiation and pelletization of lowest grade direct-shipment ores (50% Fe).
Do	Pickands Mather & Co	Pointe Noire	----do	17 (pellets per day)	Company is managing agent for a number of participating steel companies.
Do	Quebec Cartier Mining Co.	Lac Jeannine, Gagnon	Concentrate	8,000 (concentrate per year).	Open pit mine; shipment to U.S. Steel Corp. and world markets.
Do	Quebec Iron and Titanium Corp.	Lac Tio (mine), Tracy (mill and blast furnace).	Pig iron	630 (blast furnace per year).	Open pit ilmenite mine.
Ontario	Algoma Steel Corp. Ltd.	Wawa	Sintered ore	8 (ore per day)	Open pit and underground mine; siderite ore; sinter railed to Sault Ste. Marie and to Great Lakes shipment.

Do	Caland Ore Co. Ltd	Atikokan	Direct-shipment ore, pellets (from fines).	2,300 (ore per year)	Open pit mine; shipment mainly to Inland Steel Co. mine leased from Steep Rock Iron Mines Ltd.
Do	Cliffs of Canada Ltd	Adams mine, near Kirkland Lake.	Pellets	1,100 (pellets per year).	Open pit mine; magnetite ore; shipment to Dominion Foundries and Steel Ltd. (Dofasco).
Do	International Nickel Co. of Canada Ltd.	Copper Cliff	----do	600 (pellets per year)	Pyrite treated by roasting kiln reduction and atmospheric leaching.
Do	Marmoraton Mining Co.	Marmora	----do	490 (pellets per year)	Open pit mine; shipment to Bethlehem Steel Corp., United States.
Do	National Steel Corp. of Canada Ltd.	Moose Mt. mine	----do	620 (pellets per year)	Open pit mine; shipment to the United States.
Do	Pickands Mather & Co	Griffith mine, Bruce Lake.	----do	1,500 (pellets per year).	Open pit mine; shipment to Steel Co. of Canada Ltd.
Do	Sherman Mine Joint Venture.	Temagami	----do	1,100 (pellets per year).	Open pit mine; shipment to Dofasco.
Do	Steep Rock Iron Mines Ltd.	Steep Rock Lake, Atikokan.	Concentrate, pellets	640 (concentrate per year), 1,470 (pellets per year).	Open pit mine; shipment to Algoma Steel Corp. Ltd. and Detroit Steel Corp.
British Columbia	Texada Mines Ltd	Texada Island	Magnetite concentrate	5 (mill heads per day)	Magnetic concentration; shipment to Japan; open pit and underground mines.
Do	Wesfrob Mines Ltd	Queen Charlotte Islands.	----do	1,100 (concentrate per year).	Open pit mine; shipment to the United States and Japan.

[1] As of Jan. 1, 1976.
[2] Part of Labrador operation.

Source: Department of Energy, Mines and Resources, Ottawa.

per year at a cost of about $1.2 billion. It will include coke ovens, a blast furnace, two basic oxygen furnaces, and a double-strand continuous-casting machine for steel slabs. Eventually, capacity at the Nanticoke steel plant is expected to be 5.4 million tons when expansion is completed in 1990.

Algoma Steel Corp. Ltd. was nearing completion of a major investment program that would increase steel production capacity from 2.7 million tons to 3.9 million tons per year making it Canada's second largest steelmaker. In the final phase of the expansion program, a two-strand continuous-casting machine for the production of slabs up to 305 millimeters thick and from 1,016 to 2,159 millimeters wide was installed. An output of 680,000 tons of slabs annually was scheduled to commence in mid-1977. After resolving some technical problems, Algoma's new 4,500-ton-per-day blast furnace and a 1,400-ton-per-day coke oven battery, commissioned in 1975, operated at a high rate of efficiency.

Dofasco was also in the midst of expanding its steel production and processing facilities. In mid-1976, Dofasco commissioned a five-strand, 1,829-millimeter tandem cold-rolling mill which would increase the company's cold-rolling capacity to about 2 million tons per year. In addition, a new basic oxygen furnace shop was under construction that would raise Dofasco's annual steelmaking capacity from the present level of 3.1 million tons to 3.9 million tons by late 1977.

In Quebec, Sidbec-Dosco nearly completed installation of two 136-ton electric furnaces and two continuous-casting machines, one for billets and one for slabs. Completion, scheduled for early 1977, will increase the company's annual steel producing capacity from 635,000 tons to 1.5 million tons. Sidbec-Dosco took a 50.1% equity in the Sidbec-Normines project at Fire Lake, Quebec, during the year. The 6-million-ton-per-year iron ore pellet project was expected to begin operation in late 1977.

In addition to the major steel companies, several of the smaller regional steel producers also initiated expansion programs. Atlas Steel Ltd. of Rio Algom Ltd., Canada's largest producer of stainless and specialty steel, neared completion of installation of two 54-ton and one 23-ton electric arc furnaces at Welland, Ontario. These furnaces were expected to be fully operational in early 1977. Also at Welland, a new Sendzimir cold-rolling mill was commissioned in late 1976 at the Tracy, Quebec, plant. The Dominion Bridge Co. Ltd. at Selkirk, Manitoba, commissioned a new merchant-bar rolling mill. Western Canada Steel Ltd. also commissioned a 73-ton, 5.5-meter-diameter electric arc furnace to replace the existing 27-ton electric arc furnace. This would nearly double Western Canada's annual steel-producing capacity from 99,800 tons to 181,400 tons.

Lead and Zinc.—Because of work stoppages at several mines, production of both lead and zinc declined in 1976. Mine output of lead dropped 30% to its lowest level in 12 years as strikes at several major producers cut production significantly in New Brunswick and the Yukon Territory. Zinc mine production declined 3%, because of an extended strike at Cyprus Anvil Mining Corp. Ltd. and reduced output at Noranda. Metal production, however, was unaffected by the strikes, and as market conditions strengthened, lead and zinc refineries increased output.

All zinc mine production in Canada was in conjunction with lead, copper, and/or silver. By ore classification, about 40% came from zinc ores, 13% from copper ores, and the balance from mixed ores. Production from lead ores was insignificant. Likewise, approximately 30% of the mine copper, 100% of the mine lead, and 80% of the mine silver were jointly produced with zinc.

Canada strengthened its position as the world's leading zinc producer when three new mines, Nanisivik Mines Ltd., Lemoine Mines Ltd., and Northair Mines Ltd., began operation in 1976. These new operations more than offset the closure of one mine by Hudson Bay Mining & Smelting during the year.

Nanisivik commenced production at its lead-zinc-silver deposit at the northwestern end of Baffin Island, Northwest Territories. Mill capacity was 1,360 tons per day, and ore reserves were estimated to be 6.7 million tons, averaging 14.6% zinc, 1.4% lead, and 1.6 troy ounces of silver per ton. The company was expected to produce approximately 118,000 tons of zinc concentrate annually, which would contain about 60% zinc, 0.32% cadmium, and 280 grams of silver per ton. It would also produce

9,000 tons of lead concentrate containing about 65% to 70% lead and 1 to 2 troy ounces of silver per ton. Construction costs of the mine complex were estimated to be about $64 million. Completion of the townsite, airport, and road construction was scheduled for 1977. Nanisivik is owned by Mineral Resources International Ltd. (59.5%), Metallgesellschaft AG of West Germany (29.25%), and Billiton B.V. of the Netherlands (11.25%).

Lemoine, a wholly-owned subsidiary of Patino Mining Corp., completed underground development as well as a 275-ton-per-day milling plant and ancillary facilities at its Chibougamau, Quebec, deposit. Mill tuneup commenced in late 1975, and the mill went into production in early 1976. Ore reserves were estimated at 567,000 tons, grading 10.8% zinc, 4.5% copper, 3.9 grams of gold per ton, and 75 grams of silver per ton.

Northair commenced operation at its lead-zinc-gold deposit near Brandywine Falls, British Columbia, in March. The company produced some 500 tons of zinc in concentrate, which was shipped to Cominco at Trail, British Columbia, for refining. Ore reserves were estimated at 410,000 tons, grading 3.09% zinc, 2.28% lead, 9.02 grams of silver per ton, and 13.06 grams of gold per ton.

Three mine expansion programs were in progress during 1976. Heath Steele Mines Ltd. expanded the mill capacity of its zinc-lead-copper property at Little River, New Brunswick, from 2,800 tons to 3,600 tons per day. Zinc-in-concentrate production was expected to increase 16,000 tons to 46,000 tons in 1977. Brunswick Mining & Smelting Corp. Ltd. was sinking a second 1,372-meter shaft at the No. 12 zinc-lead-copper mine and expected to commence hoisting ore in 1977 when ore from the No. 6 open pit mine is exhausted. The expanded ore processing capacity from 9,100 tons to 10,000 tons per day combined with higher grade ore in the No. 12 mine was expected to increase zinc-in-concentrate capacity about 35% from approximately 190,000 tons to 256,000 tons, which would be phased in during 1979–80. Cost of the expansion program was estimated to be $53 million.

The Kidd Creek zinc-copper mine at Hoyle, Ontario, wholly owned by Texasgulf Canada, was the site of a $100 million expansion program designed to increase mine production and processing of ore to 4.5 million tons per year in 1978–79 by the addition of a 1,600-meter No. 2 shaft and a fourth circuit to the concentrator. Because the copper content of underground ore increases with depth and zinc content decreases with depth, zinc-in-concentrate production was not expected to increase as a result of this expansion. However, some zinc-rich ore was found at greater depth.

Most of the major lead-producing provinces reported a drop in lead production. In New Brunswick, output at Brunswick Mining & Smelting was down about 35% from the 1975 level. Mining operations were stopped for 4 months when the 1,200 workers at the No. 6 and No. 12 mines were on strike.

Mine output of lead from Ontario and Quebec was down slightly in 1976. This output was mainly a byproduct of copper and zinc, and the continuing softness of the market for these two metals resulted in a simultaneous lowering of the lead output. The expansion program of Texasgulf Canada at the Kidd Creek mine in Ontario was designed to increase lead output, probably less than 10,000 tons per year.

Output of lead in western Canada was up from 1975 levels. Production activity was normal at most operations. The lead-zinc-gold property of Northair, near Brandywine Falls in British Columbia, commenced production in March. Production of lead concentrate was estimated at 1,000 tons of contained lead. Mill capacity was 275 tons per day; this may be increased to about 300 tons per day in 1977. The lead concentrate was exported to the United States. Production at Cominco's Sullivan and H.B. mines was also above 1975 levels.

In northern Canada, strikes at mines in the Yukon severely restricted output, while technical problems affected output at Pine Point Mines Ltd. in the Northwest Territories. In the Yukon, Cyprus Anvil lost 169 production days as a result of strikes by mine, office, and technical workers. The last strike, which began on July 30, ended November 23 when workers agreed to a new 3-year labor contract that would expire September 30, 1978.

Of the four producers of lead in the Atlantic provinces, none showed a significant increase in output. The new No. 5

shaft at Heath Steele, was completed to a depth of 991 meters and production in 1977 will be at a rate of 3,600 tons per day, up from the previous level of 2,800 tons per day. Output of lead in 1977 was expected to increase about 30% as a result of the expansion.

Nickel.—Output increased slightly over that of 1975, with output in both 1975 and 1976 about 9% below that of 1974. The slow upturn in economic activity in industrialized countries, labor disputes, and large stock inventories adversely affected nickel output during the year. Canadian producers operated considerably below capacity, and three producers ceased operations. Falconbridge maintained the 30% cutback in production instituted in late 1975 and INCO also operated well below its capacity.

In June 1976, Sherritt Gordon closed its Farley mine at Lynn Lake, Manitoba, because of heavy operating losses. Ore reserves were limited at the time of closure. The mill and surface plant were mothballed to permit reactivation if a new ore discovery was made in the area. Kanichee Mining Inc. stopped production at its copper-nickel mining operation at Temagami, Ontario, after termination of its smelter contract. Dumbarton Mines Ltd. closed its mining operations in the Bird River area of eastern Manitoba in May because of unfavorable economic conditions.

INCO, the world's largest nickel producer, operated 15 mines, 6 concentrators, 3 smelters, and 3 refineries in Ontario and Manitoba during 1976. Production of nickel by INCO increased to 230,800 tons from 209,000 tons in 1975. Its deliveries of nickel increased to 204,900 tons, 17% above that of 1975. INCO began construction of a new $29 million plant near Sudbury, Ontario, to manufacture metal strip for coinage. The plant, scheduled for completion in mid-1977, would manufacture the coinage strip from both elemental and prealloyed metal powders. It would also have facilities for rerolling intermediate products from INCO's rolling mill at Hereford, England, and Huntington, W. Va.

Falconbridge operated nine mines, four concentrators, and one smelter in Ontario and Manitoba. Although production of the company was sharply curtailed, two major capital expenditure programs that were suspended in 1975 were reactivated in July. Sinking of the Fraser shaft on the north rim of the Sudbury Basin, which was 84% complete when work halted, was resumed. Construction was also resumed on the $97 million smelter environmental and efficiency improvement program.

In August, UMEX began operating the 3,600-ton-per-day concentrator at its Thierry deposit near Pickle Crow, Ontario. During the first year of production, the concentrator was fed from two small open pit deposits. The ore would be mined underground in succeeding years.

Two exploration projects could become nickel producers. In the Key Lake area of northern Saskatchewan, the joint venture of Uranerz Exploration and Mining Ltd., Inexco Mining Co., and Saskatchewan Mining Development Corp. was outlining two uranium-nickel deposits. These deposits have a high nickel content that would be recoverable.

Platinum-Group Metals.—Domestic production of platinum-group metals was at the highest level recorded in the last 5 years. These metals were recovered as a byproduct of the nickel-copper ores mined in the Sudbury and Shebandowan Districts of Ontario and the Thompson, Wabowden, and Bird River areas of Manitoba. The 7.7% rise in output resulted mainly from a production increase by INCO, Canada's largest producer, whose deliveries were 84% higher than in 1975. Falconbridge, with an output of 130,000 troy ounces, ranked second in production. Some smaller producers were the Langmuir mine near Timmins, Ontario, Kanichee Mining in Ontario, and Dumbarton Mines in the Bird River area of Manitoba. These producers shipped copper-nickel concentrates to INCO and Falconbridge for treatment.

In August, UMEX began recovering platinum from its Thierry deposit near Pickle Crow, Ontario. A copper concentrate containing platinum-group metals would be processed by Noranda. After extensive diamond drilling, Texasgulf Canada dropped its option on the Lac des Isles property, 80 kilometers north of Thunder Bay, Ontario.

Silver.—Production was valued at approximately $175 million, representing a decrease of about $2 million from the 1975 output. Tonnage of production, how-

ever, increased by 1.2 million troy ounces. This increase was mainly attributable to several base metal mines that produced more byproduct silver, particularly Texasgulf Canada in Ontario and Western Mines Ltd. in British Columbia. Higher output was also reported by Echo Bay Mines Ltd. and Terra Mining and Exploration Ltd. at their silver-copper properties near Port Radium in the Northwest Territories and in the Cobalt area of Ontario.

Ontario remained the leading silver-producing province, with an output of 15.6 million troy ounces in 1976. Ore and concentrate production from mines in the Cobalt area was significantly higher than in 1975. Greater output by the two main producers, Agnico-Eagle Mines Ltd. and Teck Corp.'s Silverfields Div., accounted for most of the increase. The new hydrometallurgical plant of Canadian Smelting and Refining Ltd., the operating company for the joint venture of Péchiney Ugine Kuhlmann of Paris, France, and St. Joseph Explorations Ltd., began commercial production in early 1976. The plant was especially designed to treat arsenic-rich ores and concentrates produced by the Cobalt area mines. The plant was expected to produce up to 6 million troy ounces of silver annually.

In late 1976, operations began at the new 540-ton-per-day concentrator of Canadaka Mines Ltd. in the Cobalt area. The concentrator, which replaced one destroyed by fire in May 1975, was the largest ever built in the Cobalt-Gowganda area.

At the Kidd Creek property of Texasgulf Canada, near Timmins, Ontario, the $100 million expansion program continued on schedule. Included in the program was a transition from open pit to underground mining, with mine production being increased from 3.3 million tons to 4.5 million tons of ore per year.

Mattagami Lake Mines continued development work at its Lyon Lake silver-base metals property about 8 kilometers east of the Mattabi mine in the Sturgeon Lake area of northwestern Ontario. Ore production at a rate of 1,000 tons per day was expected to begin in 1978.

In Manitoba and Saskatchewan, silver continued to come mainly from several base metals mines operated by Hudson Bay Mining & Smelting near Flin Flon and Snow Lake, Manitoba. Significant quantities of silver were also obtained from the Fox and Ruttan copper-zinc mines operated by Sherritt Gordon at Lynn Lake and Ruttan.

In British Columbia, base metal ores were the main sources of silver. Cominco, the largest silver producer in the Province, derived its output from the lead-zinc-silver ores of its Sullivan mine and from purchased ores and concentrates. Byproduct silver output from the Sullivan mine increased 9% over that of 1975. Byproduct silver output from some of the British Columbia porphyry copper mines was lower because of curtailed operations. Northair began operation of its 270-ton-per-day concentrator at the Brandywine Falls silver-gold-base metal property about 110 kilometers north of Vancouver. This is a multivein deposit, containing gold as the major metal.

A feasibility study was completed about mid-1976 on Equity Mining Corp.'s Sam Goosly silver-gold-copper property 60 kilometers south of Smithers. The company plans to bring the property into production in 1978 at a rate of 3,000 to 4,500 tons of ore per day. Reserves of ore minable by open pit methods were estimated at 39.5 million tons grading 2.8 troy ounces of silver per ton.

Silver output in the Yukon Territory declined 50% in 1976 because of labor strikes at all three producers. United Keno Hill Mines Ltd. at Elsa, Canada's fourth largest mine producer of silver, was idle for 2 months. Three suspensions in operations reduced byproduct silver output at the silver-lead-zinc mine of Cyprus Anvil at Faro more than 50%. Byproduct silver output also declined at the copper-silver property of Whitehorse Copper Mines Ltd. near Whitehorse, as a result of a 2-month strike.

In the Northwest Territories, silver output was significantly higher because of greater output by the two main producers, Echo Bay Mines and Terra Mining and Exploration. Both companies operated their silver-copper properties near Port Radium free of labor strikes during 1976.

Other Metals.—Consolidated Durham Mines & Resources Ltd. continued to increase production of antimony concentrate at its Lake George property near

Fredericton, New Brunswick. The mill output was 400 to 450 tons per day with a total production of 89,000 tons in 1976. The concentrate, which averaged about 65% antimony, was shipped mainly to Europe. Output of bismuth and cadmium, obtained as a byproduct of base metal mining, increased in 1976. Production of cobalt increased slightly; however, the value of production and the value of exports increased substantially because of price increases. Two companies, INCO and Falconbridge, produced cobalt as a byproduct of domestically produced nickel-copper ores while a third, Sherritt Gordon, recovered cobalt from imported nickel ores.

Demand for columbium remained strong, but Niobec Inc. was Canada's only producer at yearend. St. Lawrence Columbium & Metals Corp. (SLC) had serious problems and halted all activities in February, following a strike by its miners. Financial problems, in addition to those caused by the strike, forced the company to file for bankruptcy in July. The labor conflict was resolved in the latter part of 1976, but the problem of financial reorganization was still pending at yearend. SLC operated during January only and produced 136 tons of Cb_2O_5.

Demand was high for molybdenum, and shipments of oxide, sulfides, and ferromolybdenum were 15% above those of 1975. Molybdenum was recovered as a primary product at two Canadian mines, as a coproduct with copper at one mine, and as a byproduct of copper at four mines. Canex Placer Ltd.'s Endako Div., British Columbia, accounted for about 50% of Canada's production. Brenda Mines as a coproduct producer supplied about 30% of Canada's output of molybdenum, and as a byproduct producer accounted for 20% of the output.

Demand for Canadian ferrosilicon was weak in 1976. However, another large manufacturer of silicon metal and ferrosilicon began operations in Becancour, Quebec. This company, Sueddeutsche Kalkstickstoffwerke AG of West Germany, began production in July. Built at a cost of $50 million, the plant had an annual production capacity of 27,000 tons of ferrosilicon and 23,000 tons of silicon.

Demand for tantalum remained at the low level of 1975. Output by Tantalum Mining Corp. of Canada Ltd. (Tanco), Canada's only producer, amounted to about 135 tons, a drop of 25% from that of 1975. Tanco's mine and mill were located at Bernic Lake in Manitoba. At the end of 1975, the company had reserves for only another 5 to 7 years of mining. As a result, Tanco began an extensive exploration program in 1976 to develop new reserves. By June, 3 additional years of reserves had been identified.

Quebec Iron and Titanium Corp. (QIT) was the only producer of ilmenite in Canada. The deposit was located in the Havre St. Pierre District of Quebec, and the ilmenite ore was processed in the Sorel area of Quebec. QIT produced 814,059 tons of titanium slag, an increase of almost 9% above its 1975 output.

Production of tungsten trioxide totaled 2,000 tons, up 40% from that of 1975. Canada Tungsten Mining Corp. Ltd., with its mine and mill in the Flat River Valley of the Northwest Territories, remained Canada's only producer of tungsten. The increased output was attributed to improved market conditions and better operating results. The mill rate, mill-head grade, and tungsten recovery rate were all above the 1975 levels. Brunswick Tin Mines Ltd. continued pilot plant tests on its tungsten-molybdenum-bismuth deposit at Mount Pleasant, New Brunswick. Amax Exploration, Inc., worked on a tungsten deposit at Mac Tung, Northwest Territories. While both deposits seem to have economic potential, no production decisions were made during the year. Cordilleran Engineering Ltd. announced that it had found an area of extensive tungsten mineralization on the British Columbia-Yukon Territory border.

NONMETALS

Asbestos.—Shipments rebounded in 1976 after the problematical year of 1975 and almost reached the 1974 shipment rate. Available capacity was inadequate for the strong demand during the year. Strong prevailing prices and anticipated high future demand spurred exploration for new asbestos prospects and evaluation of known deposits particularly in Quebec and Ontario.

The production rate was cut back at United Asbestos Inc.'s mine, 27 kilometers

southwest of Matachewan, Ontario, while equipment was installed to meet environmental requirements. The company expected to be at full operational capacity of 90,000 tons of fiber per year in early 1977.

Canadian Johns-Manville Co. Ltd.'s Asbestos Fibre Div. planned to spend $77 million during 1976–81 in expansion at the Jeffrey mine, Asbestos, Quebec, the largest asbestos mine in Canada. Expenditures in 1976 totaling $12.5 million were for purchase of property in the mine area, repairs, and new facilities.

Asbestos Corp. Ltd. decided not to rebuild the King-Beaver mill at Thetford Mines, Quebec. The mill was destroyed by fire in late 1974. King-Beaver ore will be processed at the Normandie mill, Black Lake, Quebec, probably beginning in 1977, when Black Lake ore is expected to be mined out. In the meantime, ore from the King-Beaver underground operations was treated at Asbestos Corp.'s British Canadian mills at Black Lake.

Brinco Ltd. of Montreal, Quebec, and ASARCO Inc. of New York began preliminary discussions for development of a large asbestos deposit owned by Abitibi Asbestos Mining Co. Ltd., located 84 kilometers north of Amos, Quebec. Brinco held a 55% interest in Abitibi. An estimated $300 million investment would be necessary for a 220,000-ton-per-year operation. Ore reserves were 100 million tons containing 3.5% recoverable asbestos fiber.

Late in the year, the newly elected Provincial government in Quebec indicated an intention to acquire control over the asbestos industry in the Province.

Cement.—Cement shipments declined again in 1976. Contracts for sales in the improving U.S. construction industry provided an important market for Canadian cement. According to Statistics Canada, shipments were valued at $339.2 million in 1976 and $320.2 million in 1975.

Expansions and modernizations were underway. There were also shutdowns and terminations of clinker production. Companies abandoned old, less efficient, and costly-to-operate equipment and planned conversions to the dry process and energy conservation.[4]

The energy intensive cement industry, which consumed about 4% of the industrial total, planned a 12% energy savings by 1980.

Theoretical annual capacity was 15.1 million tons at yearend. This capacity was distributed as follows, by province: Ontario, 43.7%; Quebec, 27.1%; the Western provinces, 24.4%; and the Atlantic provinces, 4.8%.

Fertilizer Materials.— *Phosphate.*—International Minerals & Chemical Corp. (Canada) Ltd. (IMC) completed a first-stage exploration program on a deposit, discovered in 1975 near Kapuskasing, Ontario, 640 kilometers northwest of Toronto. Reserves were estimated at 56.7 million tons at 20% P_2O_5.

Erco Industries Ltd. was rebuilding the No. 2 furnace at the elemental phosphorus plant at Long Harbour, Newfoundland. Upon completion, annual capacity will be 72,500 tons.

Potash.—Production and sales were up, compared with those of 1975, although prices were soft during the year. Sales were nearly 14% higher overall and nearly 29% higher to U.S. markets. The 10 operating mines worked at slightly over 50% of capacity through August and at or near full capacity the remainder of the year. IMC, the leading producer, announced plans for expansion from 3.5 million tons to about 4 million tons KCl per year at its two mines near Esterhazy in eastern Saskatchewan.

The Saskatchewan Provincial government continued negotiations with several of the potash producers for effective control of the potash industry in the Province through purchase of all Provincial potash mining assets. In August, the first transfer of ownership, that of the mine owned by Duval Corp. of Canada, was announced. Potash Corp. of Saskatchewan (PCS), the Provincial Crown company, announced purchase of the mine and related assets of Duval Corp. for $128.5 million, with transfer of property and management by October. PCS renamed the mine as the Cory mine after its location near Saskatoon, announced plans for a 25% expansion, and assured job security and no production or supply disruptions. By yearend, PCS was negotiating with four other com-

[4] Grancher, R. A., and E. W. Stearn. Increased Cement Shipments Require Pricing Policy Support. Rock Prod., v. 79, No. 12, December 1976, pp. 47–48.

Table 9.—Canada: Planned cement capacity changes in 1976

Province	Company	Plant location	Capacity change (thousand metric tons per year)	Expected completion date	Estimated cost (millions)	Remarks
Nova Scotia	Canada Cement Lafarge Ltd.	Brookfield	+238	1977	$25	Capacity doubled.
Quebec	----do	Montreal East	−450	1976	13	General rehabilitation, 2 kilns to replace 7 kilns, conversion from wet process to dry process.
Do	----do	Hull	−190	1976	2	New finish grinding mills, clinker production terminated in 1975.
Ontario	St. Marys Cement Ltd	St. Marys	+640	1976	30	Sixth kiln, new mill.
British Columbia	Ocean Construction Supplies.	Vancouver	+1,000	1978	90	New plant at Tilbury Island.
Do	----do	Bamberton	−650	1978	--	Clinker production to be phased out.
Total			+588		160	

Source: Department of Energy, Mines and Resources, Mineral Development Sector, Ottawa.

Table 10.—Canada: Construction materials shipments

Commodity	1975		1976 p	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Cement	9,961,111	$320,173	9,850,000	$339,159
Clays and clay products	NA	85,977	NA	92,110
Gypsum	5,719,451	20,304	5,661,000	22,906
Lime	1,601,624	46,907	1,825,000	54,099
Sand and gravel	247,155,421	305,180	247,661,000	320,800
Stone	88,920,782	202,099	87,180,000	209,600
Total	NA	980,640	NA	1,038,674

p Preliminary. NA Not available.

Source: Statistics Canada.

panies (Hudson Bay Mining & Smelting, Alwinsal Potash of Canada Ltd., Allan Potash Mines Operators Ltd. (APM), and Central Canada Potash Co. Ltd.). Acquisition of these properties would give PCS control of nearly 50% of the potash production in the Province at an estimated cost in excess of $500 million.

In January, the Saskatchewan legislature voted final approval of the Potash Development Act, empowering the Province to acquire ownership, through purchase or expropriation, of part or all of the potash industry. The Potash Corp. of Saskatchewan Development bill was also passed, creating PCS as a Crown corporation with headquarters in Saskatoon. Bills were also introduced with amendments redefining the prorationing system, the PCS Development bill, and expropriations relating to the Federal Income Tax Act and mine valuations.

In June, the U.S. Department of Justice announced a Federal grand jury indictment, with charges against U.S. potash producers with operations in Canada for violations of the Sherman Anti-Trust Act by fixing prices and production rates during 1969–74 beyond regulations of the Provincial prorationing program.

In January, the government of New Brunswick concluded an agreement with IMC for exploration and development work for potash and salt in a 200-square-kilometer area near Salt Springs, Kings County. A high-grade sylvite and halite bed reportedly lies at a depth of 600 meters. IMC was to spend $1 million in the first exploration stage, and if the deposit proved economic, development and mining would follow within specified times.

IMC was also drilling out a potash discovery near Kapuskasing, 640 kilometers northwest of Toronto, in Cargill Township, Ontario.

Potash Co. of America, also granted an exploration contract for potash in New Brunswick, was working near Sussex.

Table 11.—Canada: Potash producers, Saskatchewan Province, 1976

Operating company	Mine location	Capacity (thousand metric tons)	
		KCl	K_2O equivalent
Alwinsal Potash of Canada Ltd.[1]	Lanigan	900	540
Allan Potash Mines Operators Ltd.[1]	Allan	1,360	830
Central Canada Potash Co. Ltd.[1]	Colonsay	1,360	820
Cominco Ltd	Vanscoy	1,090	650
Hudson Bay Mining & Smelting Co. Ltd.[1]	Rocanville	1,090	660
International Minerals & Chemical Corp. (Canada) Ltd.	Esterhazy	1,900	1,160
Do	----do	1,560	950
Kalium Chemicals Ltd	Belle Plaine	1,360	850
Potash Co. of America	Saskatoon	690	420
Potash Corp. of Saskatchewan	Cory	1,090	660
Total		12,400	7,540

[1] Negotiations for purchase by Potash Corp. of Saskatchewan were underway at yearend.

Source: Department of Mineral Resources, Saskatchewan.

Fluorspar.— Production of concentrates, containing about 70% CaF_2, at Alcan's Newfoundland Fluorspar Div. near St. Lawrence, Newfoundland, was down 50% from normal output because of a strike lasting for several months at Alcan's aluminum smelting facilities at Arvida, Quebec, where the concentrates are shipped for use in the manufacture of aluminum fluoride.

Shaft sinking and other mine development continued north of St. Lawrence, where new reserves have been discovered. Mining will be at a depth of 460 meters. An initial production rate of 450 tons per day was scheduled for 1977.

Sulfur.—Sulfur production was down 3% from that of 1975 and was 10% below that of the record year of 1973. The decline reflected stagnation in development of new sour natural gas reserves and reduced output of natural gas. During the year, 42 sour natural gas plants in Alberta, 2 in British Columbia, and 1 in Saskatchewan operated with a combined annual capacity of 9.2 million tons.

Sulfur was also obtained from crude oil, the Athabasca bituminous sands, smelter gases (in the form of sulfuric acid), and pyrite concentrates (for sulfuric acid). However, sulfur from sour natural gas was the most important source in Canada, particularly in Alberta, where it occurred as hydrogen sulfide in varying quantities in many reservoirs.

Sulfur produced from smelter gases (as contained sulfur in sulfuric acid) totaled 781,000 tons, an increase of 12% over that of 1975. Smelter gases will continue to increase in importance as a source of sulfuric acid in Canada, as current output is expected to double by 1985. Pyrite shipments were virtually stopped as acid producers formerly using pyrite either closed down or converted to elemental sulfur.

Canada was the world's largest exporter of sulfur, accounting for over 30% of total sulfur trade. In 1976, Canada's elemental sulfur exports rose about 8% over 1975 exports to 3.4 million tons, but were still below the record 1974 sales. Shipments to the United States returned to the 1974 levels. Shipments to Asian markets, for many years a significant outlet for Canadian sulfur, rose 25% in 1976, also returning to 1974 levels.

African markets were becoming a major destination for Canadian sulfur, increasing from less than 10,000 tons in 1972 to over 400,000 tons in 1976. The Republic of South Africa received about 75% of this tonnage. Similarly, South America has grown rapidly as an outlet for Canadian sulfur, exceeding 400,000 tons in 1976, more than three times the 1975 level. Brazil accounted for about 65% of these purchases.

Sulfur prices have been volatile over the years, varying between an annual average price of $37 per ton f.o.b. Alberta in 1968 to $5 per ton in 1973. The boom in 1974 raised the price to $25 and depressed markets during 1975 and 1976 resulted in a fall to below $20.

MINERAL FUELS

Coal and Coke.—Because of some major coal miners strikes during the year, Canada's coal production remained virtually unchanged from that of 1975. While bituminous coal production declined about 1.3 million tons, output of both subbituminous coal and lignite increased. Also because of the strikes and soft markets for spot coal sales, exports were down 252,000 tons. Of the total coal consumed in Canada, about 16.8 million tons was used to generate electricity in thermal power stations, and about 7.4 million tons of coking coal was carbonized to make 5.3 millon tons of coke.

Three new coal mines were in various stages of development, and several companies were expanding operations during 1976. In Nova Scotia, production from Cape Breton Development Corp.'s (Devco) new Prince mine was increased and it was expected to reach capacity in 1977. In Saskatchewan, the Saskatchewan Power Corp. (SPC) began production from its Souris Valley surface mine near Estevan. In Alberta, Luscar Sterco Ltd. decided to proceed with its surface mine southeast of Hinton, after receiving Alberta government approval. Production was expected by mid-1978. Several companies were expanding established mines during 1976, mainly for subbituminous coal in Alberta and lignite in Saskatchewan to fuel electric power stations. Exploration and evaluation work on several prospects in Alberta was discontinued following release of Alberta's new coal zoning conditions.

Many of the coal-producing provinces either announced new coal policies or were actively reviewing their existing policies during 1976. In June, the government of Alberta announced a new coal development policy. This policy stated that the use of Alberta's coal resources was designed to give maximum benefit to the people of Alberta. Development of coal for use in Alberta power stations was given priority with strong emphasis on proper regard for the environment. The new coal policy also included a royalty system of a flat $0.10 per short ton of coal produced. The royalty became effective July 1, 1976, and was based on a percentage of the selling price of coal after factors were calculated for cost, revenue, and investment. The minimum royalty applicable would be 5%.

Ontario Hydro finalized a contract with Thunder Bay Terminals to transport 3.2 million tons of coal annually from western Canada to central Canada by 1981.

In British Columbia, coal production by Kaiser Resources Ltd. near Sparwood in the Crowsnest Pass area was halted for 30 days by a coal miners strike. Production in 1976 declined 15% to approximately 5.5 million tons of clean coal. Also affected by the strike were the expansion of the Elkview preparation plant and development of Panel 6 of the underground hydraulic mine. On April 1, 1976, Kaiser and its Japanese customers negotiated a basic price of $50.91 per ton f.o.b. Vancouver for coking coal. With the application of escalation factors the price increased to $53.30. This price established the pattern for most of the other Canadian coking coal producers with long term Japanese contracts.

Four companies in Alberta produced coking coal. Output for 1976 totaled about 14 million tons of coal in the two main categories of subbituminous and bituminous material. At Grand Cache, McIntyre Mines Ltd. produced approximately 1.9 million tons of coal from one underground and two surface mines. McIntyre shipped 1.5 million tons of coal to Japan under terms of a 3-year contract that expires in 1978. During 1976, McIntyre also shipped small volumes of coal to Hamilton, Alberta, for both Stelco and Dofasco and to Sydney, Nova Scotia, for Sydney Steel Corp. Cardinal River Coals Ltd. produced nearly 1.7 million tons of coking coal at its Luscar surface mine, near Hinton, during 1976. Cardinal River planned to expand the mining operation by about 500,000 tons per year. The principal consumers of Alberta's coal were Calgary Power Ltd. (CPL) and Alberta Power Ltd. (APL). CPL, which produced about 65% of the electrical power in the Province of Alberta, operated two large coal-fired thermal stations. The remainder of the electrical power came from two large coal-fired steam turbine installations.

In Saskatchewan, only lignite was produced from five surface mines in the southeastern Estevan-Bienfait region. Production in 1976 totaled 4.7 million tons, up about 1.2 million tons from that of 1975. Most of the production was sold to SPC for use in its power stations. The other important lignite market was in Manitoba where shipments were made to the Manitoba Hydro-Electric Board for power station use.

Coal in New Brunswick was mined in the Minto-Chipman area by New Brunswick Coal and Railway Co. Production amounted to approximately 320,000 tons, down about 90,000 tons from that of 1975; about 275,000 tons was sold to the New Brunswick Electric Power Commission's coal-fired power station at Grand Lake. A new coal-fired unit being built at Dalhousie by New Brunswick Electric was scheduled for operation in mid-1979. This unit was expected to burn approximately 275,000 tons of coal annually, which should improve coal market conditions in the Province.

Production increased 20% to 1.9 million tons in Nova Scotia during 1976. Devco produced about 97% of the total from its three expanded underground mines. Devco's newest mine, the Prince mine at Point Aconi, produced 215,000 tons of coal. An annual rate of 725,000 tons was expected by 1977 if markets warrant it. At Lingan, a major change was made in the belt haulage system to improve the efficiency of coal movement out of the mine. Three longwalls were operated in 1976 as production increased to 1.1 million tons.

Natural Gas.—Production decreased marginally in 1976. The wellhead value of marketable gas production was $2.5 billion compared with $1.5 billion in 1975.

Table 12.—Canada: Principal coal mines in 1976 [1]

Province	Company	Mine and location	Estimated production (thousand metric tons)	Remarks
Nova Scotia	Cape Breton Development Corp.	Lingan mine, Lingan	1,233	Underground; coal for power generation.
Saskatchewan	Manitoba and Saskatchewan Coal Co. Ltd.	Boundary Dam mine, Estevan	1,510	Open pit; lignite for power generation.
Do	Utility Coals Ltd	Utility mine, Estevan	1,247	Do.
Alberta	Manalta Coal Ltd	Whitewood mine, Wabamun	2,059	Open pit; coal for power generation.
Do	----do	Highvale mine, Sundance	2,589	Do.
Do	Coleman Collieries Ltd	Tent Mountain mine, Coleman.	1,274	Open pit; coking coal for export to Japan.
Do	Cardinal River Coals Ltd	Cardinal River mine, Luscar	2,253	Do.
Do	McIntyre Mines Ltd	Smoky River mines, Grand Cache.	2,073	Open pit and underground; coking coal for export to Japan.
British Columbia	Kaiser Resources Ltd	Harmer Ridge, Sparwood	5,987	Open pit and underground; leading producer in country; coking coal for export to Japan.
Do	Fording Coal Co. Ltd	Fording mine, Fording Valley	2,401	Open pit ranks second as producer; coking coal for export to Japan.

[1] Those producing more than 1 million short tons (approximately 900,000 metric tons) during the year.

Source: Department of Energy, Mines and Resources, Ottawa.

Table 13.—Canada: Coal trade in 1976 [p]

(Thousand metric tons and thousand dollars)

	Quantity	Value
Exports:		
Japan	10,293	513,211
Korea, Republic of	355	18,275
France	103	1,959
Denmark	268	5,407
United States	22	390
Germany, West	258	6,560
Other	144	3,963
Total	11,443	549,765
Imports for consumption:		
United States	15,022	559,730

[p] Preliminary.

Source: Statistics Canada.

Increases in prices late in 1975 and again in 1976 were responsible for the increase in gas value. Sales of gas to customers in Canada were 1.3 trillion cubic feet, slightly below the 1975 level. Commercial consumption increased, but both residential and industrial consumption declined. The value of natural gas sold domestically amounted to $1.4 billion, an increase of $97 million over that of 1975.

Export sales of natural gas to the United States increased slightly to 957,000 million cubic feet. This marked the third consecutive year that export volumes were below the authorized level of about 970 million cubic feet. The decline undoubtedly resulted from the Federal Government's decision to cut back on natural gas exports because of predicted shortages in Canada for 1976. These shortages did not develop, and there were no further plans to substantially reduce natural gas exports to the United States.

There were major natural gas discoveries in the foothills of Alberta, particularly in the Burnt Timber, Wilson Creek, and Limestone Mountain regions. In addition, a Devonian reef gas discovery was made in the Pinto region of western Alberta, about 32 kilometers west of the Berland River Field. Early indications were that these were substantial discoveries although their true significance would only be known after a more complete evaluation. In northwestern Alberta, a significant new shallow gas trend was continuing to develop near the scene of the Keg River oil discoveries of the 1960's. Several discoveries were made there in the Bluesky Formation of Cretaceous age in 1974, and since then several successful followup wells were drilled expanding the known limits of the productive area.

In the Arctic Islands, Panarctic Oil Ltd. made two significant gas discoveries in April. The first was a major northwestward extension to the Hecla gasfield off the Sabine Peninsula, Melville Island. The well was drilled 24 kilometers offshore in 30 meters of water from an artificially thickened ice pad. The Hecla Field was now over 40 kilometers long and was estimated to contain upward of 5 trillion cubic feet of natural gas. The second gas discovery was at a well drilled 6 kilometers offshore from Ellef Ringnes Island in 61 meters of water about midway between Panarctic's King Christian Island gasfield and the gasfield at Kristoffer Bay on Ellef Ringnes Island. The well was drilled on a separate structure from those of the two previous discoveries.

Work was resumed on two potential gas discoveries made in 1975 on the Labrador Shelf. One of these, Eastern Snorri, located about 1,100 kilometers north of St. John's, Newfoundland, yielded significant flows of gas and condensate and was considered to be a potential commercial discovery. The other well, Karlsefni H–B, also penetrated a gas- and condensate-bearing reservoir, but it was not considered to be commercial at the present time.

On the Grand Banks and Scotian Shelf, exploration was declining as results had been costly and disappointing. The only discoveries made in this region were in the vicinity of Sable Island, but currently all of these were considered to be noncommercial.

On August 31, a consortium headed by Foothills Pipelines filed an application with the NEB for permission to construct 824 kilometers of 1,067-millimeter-diameter gas pipeline in the Yukon Territory as its contribution to the proposed Alcan project to transport Alaskan natural gas to U.S. markets. The system would follow the trans-Alaska crude oil pipeline currently under construction to Fairbanks, Alaska, and then parallel the Alaska Highway to the Alberta border, where it would connect with the Alberta Gas Trunk Lines Co. and Westcoast Transmission Co. Ltd. systems. The NEB decided to incorporate the Alcan proposal in the hearing currently

underway on the northern pipeline proposals of Canadian Arctic Gas Study Ltd. (CAGSL) and Foothills. The NEB decided that having a consolidated hearing for the three projects, rather than having a separate hearing on the Alcan project, would result in a faster decision as to which pipeline proposal would eventually be approved.

Canadian natural gas prices, which were set at $1.25 per thousand cubic feet at Toronto city gate, were increased to $1.40 in July and to $1.50 on January 1, 1977. In September 1976, the export price was increased from $1.60 to $1.80 per thousand cubic feet, and again at yearend it increased to $1.94. The increase follows the Federal Government policy of receiving full market value for this commodity. Canadian producers would receive a wellhead price for gas of $1.22 per thousand cubic feet on January 1, 1977, up from $0.99 in effect during 1976.

The Energy Resources Conservation Board reported marketable natural gas reserves at 53.7 trillion cubic feet on December 31, 1975, and at 55.5 trillion cubic feet on December 31, 1976. Most of the reserves were located in Alberta, where the 1976 total was estimated at 53,302 billion cubic feet. This represents an increase of 4% over that of 1975.

Petroleum.—Production of crude oil (including synthetic crude and natural gas liquids) continued the downward trend which began in 1974. In 1976, output was down 6% from that of 1975. Conventional crude oil production declined 6% and that of natural gas liquids dropped 7%. Production of synthetic crude oil, however, was up 9% over that of 1975. The overall decrease in production of crude petroleum resulted from lower export quotas to the United States. The increase in domestic requirements coincident with the opening of the interprovincial pipeline extension from Sarnia to Montreal failed to offset the limitations on exports.

In May, the Federal Government announced the terms of a territorial Petroleum and Natural Gas Act. The Act would provide for a new regulatory system to govern the manner in which oil and gas rights were made available for development in Canada's territories and offshore regions. The new legislation was designed to promote early assessment of Canada's frontier oil and gas resources through incentives to explore.

The Act also had elements to stimulate exploration which include fiscal and landholding incentives, together with complementary provisions for greater Government control over the rate and level of exploration, development, and production activities. In addition, the legislation would permit Canadian firms to benefit more fully from the development of Canadian resources.

Encouraged by rising crude oil prices and drilling incentives by provincial governments, the number of wells completed in 1976 increased 20%. There were 5,100 wells and 4,938 kilometers drilled, the highest in both categories since 1965. Alberta was the main area of drilling activity, accounting for 90% of wells completed and 85% of total kilometers drilled. These represent increases of over 25% for wells drilled and 34% for kilometers drilled over those of 1975. In British Columbia, both kilometers drilled and number of wells drilled increased substantially, but drilling activity in Saskatchewan and Arctic areas declined. Drilling activity remained about the same in the eastcoast offshore area. There were no significant oil discoveries.

Interest remained high in the development of vast resources of heavy oil in the Cold Lake area of eastern Alberta. Imperial Oil Ltd., one of the pioneers in Cold Lake oil sands development, has spent about $40 million since 1964 experimenting with potential extraction methods. During 1976, the company operated a 56-well steam-injection project. Production totaled approximately 10,000 cubic feet per day which was shipped to Imperial's new Strathcona refinery in Edmonton as feedstock for asphalt. Depending on technical success in the pilot stage, Imperial eventually intends to expand this project to an ultimate production of 567,850 cubic feet per day.

Great Canadian Oil Sands Ltd. (GCOS) remained Canada's only commercial synthetic crude oil producer. Operations from the bituminous sands at Athabasca, Alberta, resulted in crude production of 17.5 million barrels compared with 15.5 million barrels in 1975. The higher level of production was influenced by increased crude oil prices instituted by the Government on

July 1. Improved economics, largely as a result of increasing crude oil prices and possible incentives of reduced royalty and tax payments, were expected to speed up tar sands development in the next decade. Canada planned to reduce dependence on imported oil in the 1980's, and both Federal and provincial governments considered that work on the Athabasca tar sands must be expedited.

Output by GCOS would have been greater except for mechanical difficulties and the occurrence of pockets of lean sand during first quarter mining. There were also problems with the power and steam facilities and the sulfur plant during the last quarter. Overall, however, operations saw less mechanical downtime than in previous years. This was particularly true in overburden removal where the time that equipment was available increased substantially over that of 1975 and resulted in record removal of material. This improvement eliminated the need to hire outside contractors to supplement company efforts. More stable operations also characterized the extraction plant, and levels of bitumen production were well above average.

Fabrication of the third large bucket wheel by GCOS was completed in late 1976 and, following testing, operation commenced in December. Although it is approximately the same size as the company's two original mining machines, it has a greater capacity. Its primary function would be overburden removal, but it also had the flexibility to mine oil sand.

The Petrofina Canada Ltd. consortium announced that the planned 121,250-barrel-per-day Athabasca tar sands extraction plant would be shelved indefinitely. Petrofina gave rising costs and lack of Government incentives as reasons for its actions. Shell Canada Resources Ltd. and Home Oil Co. Ltd., both of which had intentions of constructing Athabasca tar sands plants, also postponed their plans pending further economic studies. On the other hand, Syncrude Canada Ltd.'s $2 billion tar sands plant, located 48 kilometers north of Fort McMurray, Alberta, was more than 60% complete at yearend. Mining and extraction would be applied to those sands that lie within 60 meters of the surface. Major research and technological areas that were concentrated upon in developing the project included mining, extraction, froth treatment, diluent recovery, and upgrading of the bitumen. The 124,375-barrel-per-day plant was scheduled to begin operating in mid-1978.

Alberta established the Alberta Oil Sands Technology and Research Authority (AOSTRA) to advance tar sands technology. This was undertaken to study processes of recovering the oil from sand deposits to a depth of 600 meters. Amoco Canada Petroleum Co. Ltd. signed a contract for a $46 million joint venture with AOSTRA to study the recovery of bitumen from the Athabasca tar sands. Under the agreement, Amoco Canada and AOSTRA would contribute $23 million each by 1980 for development of a pilot project which would involve 25 wells. Production was expected to reach a level of over 1,000 barrels per day of bitumen.

Refinery capacity was increased substantially, mainly because of the completion of Irving Oil Company Ltd.'s refinery expansion from 140,000 barrels to 234,000 barrels per day. By 1978, refinery capacity was expected to be about 2.5 million barrels per day with the completion of Texaco Canada Ltd.'s 94,375-barrel-per-day refinery at Nanticoke and Petrosar Ltd.'s large facility at Sarnia, Ontario. In spite of the closure of Newfoundland Refining Co. Ltd. 99,400-barrel-per-day refinery in Newfoundland, Canada was expected to have a surplus of refinery capacity for several years. This was attributed to a sharp decline in exports of petroleum products during the last 2 years.

Uranium.—Production was substantially above that of 1975. This rise was attributed to an increase in the number of producers. Shipments, including some from inventory, totaled 5,100 tons U_3O_8, slightly less than that of 1975. Of the total production, over 80% came from Denison Mines Ltd. and Rio Algom Ltd. at Elliot Lake, Ontario. The remainder came from Eldorado Nuclear Ltd. near Uranium City, Saskatchewan; Gulf Minerals Canada Ltd. at Rabbit Lake, Saskatchewan; and Madawaska Mines Ltd., which began production near Bancroft, Ontario. Increased exploration activity was evident in most provinces and territories, but northern Saskatchewan emerged as the prime exploration area. A shortage of skilled miners continued to plague the industry despite training and new housing for the workers.

Denison Mines, Canada's largest uranium company, produced 1,411 tons of U_3O_8 during 1976, 7% above the 1975 level of 1,320 tons. Deliveries were made from production and from stockpile. Tonnage milled increased 14% to 1.5 million tons in 1976. On several occasions the mill achieved the planned 7,100-ton-per-day ore capacity, but it averaged 6,000 tons, well ahead of the average 3,800 tons per day of 1975. Introduction of larger equipment, construction conveyorways, and manpower training programs were among steps taken to increase mine capacity.

Rio Algom was well into its expansion program to gradually increase production and to reactivate the Panel mine, located near its Quirke property. A comprehensive environmental, engineering, and operating study of the Panel mine was scheduled for completion by mid-1977. At that time, the optimum milling rate as well as a definitive estimate of the capital cost will be determined. New housing will be constructed, in addition to the extensive housing program already underway in connection with the Quirke expansion.

In mid-1976, the joint Gulf Minerals Canada Ltd./Uranerz Canada Ltd. open pit operation at Rabbit Lake, Saskatchewan, reached full capacity. The mine and mill were operated on a 7-day week, two 12-hour shifts basis. At yearend, the open pit was about 30 meters deep and will ultimately reach a depth of over 120 meters. The plant was designed to process about 1,800 tons of ore per day and production was expected to total about 1,730 tons U_3O_8 annually.

Also in Saskatchewan, Amok Ltd. continued development work on its Cluff Lake deposits. Final feasibility studies were completed in early 1976 and mill design was underway. A two-phase operation was envisaged, at a total cost of some $133 million, for an annual output of 1,540 tons U_3O_8 by 1979.

Madawaska Mines completed rehabilitation of the former Faraday mine and mill located near Bancroft, Ontario, in August. Late in the year, the mill had reached a capacity of 680 to 725 tons of ore per day. Full capacity of 1,360 tons per day was expected in early 1977.

Uranium exploration activity in Canada remained high, involving not only mining companies but Federal, provincial, and foreign governments as well. Electric power utilities, both foreign and domestic, were also financially backing uranium exploration programs. Work was conducted in all provinces and territories with the possible exception of Prince Edward Island. In Saskatchewan, the joint venture partners Inexco Mining Co., Uranerz Exploration and Mining Ltd., and Saskatchewan Mining Development Corp. discovered a deposit in the Key Lake area, near their Gardner ore body that was discovered in 1975. The partners discovered the Deilmann ore body in June. This deposit is approximately 320 meters long and 70 meters wide, with uranium ore varying from 6 to 35 meters in thickness. In the same area, Colt Resources Ltd. discovered a 200- by 30-meter area containing uranium ores on its Highrock Lake property. Tyee Lake Resources Ltd. made a discovery in the Hydraulic Lake area about 23 kilometers southwest of Kelowna, British Columbia. Drilling by Tyee Lake showed U_3O_8 values ranging from 150 to 2,000 grams per ton for thicknesses from 1 to 30 meters.

The comparison of 1975 and 1976 estimates of recoverable resources by the Uranium Resource Appraisal Group was as follows, in thousand tons U_3O_8:

Price per pound U_3O_8	Measured		Indicated		Inferred		Total	
	1975	1976	1975	1976	1975	1976	1975	1976
Up to $20	74	94	97	104	205	280	376	478
$20–$40	13	5	20	13	101	82	134	100
Total	87	99	117	117	306	362	510	578

The comparison shows a 14% increase in measured reserves over the quantity reported in 1975. Indicated reserves remained the same, while inferred reserves increased 18%. The increase was attributed in part to more extensive study of deposits in established mines and in part to new discoveries.

In December, Canada strengthened requirements applying to the export of nuclear reactors and uranium. Under the new policy, shipments would be made only to those countries which ratify the Non-Proliferation Treaty. The Saskatchewan government instituted a new two-part uranium royalty system, effective August 1. First, there would be a basic royalty of 3% of the gross value of sales. Second, there would be a graduated royalty, with the marginal rate of tax being determined on the basis of the rate of return on capital invested in the project.

As of June, total contractual export commitments by domestic producers were about 84,000 tons U_3O_8. Although several small Canadian uranium sales were mentioned, only one new contract was approved by the Atomic Energy Control Board (AECB). That contract was between Agnew Lake Mines Ltd. and a Republic of Korean utility for the delivery of 230 tons U_3O_8. Other sales by Agnew Lake to the United States and Swedish utilities were awaiting AECB approval at yearend. Domestic utilities contracted for 30,000 tons of U_3O_8 through 1990 to provide fuel for 11,900 megawatts-electric of nuclear generating capacity.

The Mineral Industry of Chile

By George J. Coakley [1]

Chile ranked 2d in world copper and iodine production in 1976, 3d in molybdenum and rhenium, 5th in vanadium, 9th in silver, and 13th in iron ore. Although production was declining, Chile also remained one of the world's major sources of natural nitrates. Rebounding from a period of extreme inflation and the domestic and world recession of 1975, the gross domestic product, in constant 1976 dollars, increased 4% to $8.7 billion.[2] With exports of $2.1 billion, approximately 70% of which were mineral exports, Chile showed a favorable balance of trade for the year. Aided by increased copper production and higher iron ore and molybdenum prices, the value of mineral exports increased 38% to $1.4 billion.

Resulting from a policy of full production to maximize foreign exchange revenues, copper, molybdenum, and silver output all reached record highs in 1976. Weak export demand kept iron ore production down. Nitrates, petroleum, and coal production continued to decline. Increased demand for crude petroleum added $300 million to import costs in 1976.

In an effort to encourage increased participation of foreign investment in developing Chile's wealth of natural resources, the Government withdrew from the Andean Pact and its restrictive trade agreements and issued more laws modifying foreign investment regulations, restructuring the copper industry, and specifying new procedures for foreign participation in copper, petroleum, and uranium developments.

Most major investments in 1976 were concentrated on modernizing and maintaining productive capacity in the copper and iron industries and on constructing a major iron ore pelletizing plant in the Huasco Valley. A priority effort to increase Chile's energy independence met with initial success as the first major offshore drilling platform working in the Strait of Magellan hit petroleum or natural gas in four of the first five holes drilled.

Government Policies and Programs.—The Chilean Government experienced continued delays in finalizing several new foreign investment contracts under negotiation to exploit the undeveloped Andacolla, El Abra, Quebrada Blanca, and Los Pelambres copper deposits. On October 30, 1976, in an effort to improve the foreign investment climate, Chile withdrew from the Andean Pact and from the obligations of the Pact's Decision No. 24 restricting foreign investment, the repatriation of capital, and import tariff levels within the Andean region. On March 18, the Foreign Investment Statute was modified under Decree Law No. 1748 to extend the commitment to complete agreed-upon investments in mining from 8 years to 12 years, to limit total income tax levels to 49.5%, and to lighten tariffs on imported machinery and equipment. Also, discrimination between foreign and domestic companies would not be allowed.

Under Decree Law No. 1350, effective April 1, 1976, the five major copper-mining companies were dissolved and a new State-owned enterprise, Corporación Nacional del Cobre de Chile (Codelco-Chile), was created. Codelco-Chile will operate as a single company, with four operating divisions in Chuquicamata, Salvador, Andina, and El Teniente. The Chuquicamata Divi-

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Chilean pesos to U.S. dollars at the rate of 17.42 pesos=US$1.00.

sion encompasses both the Chuquicamata and Exótica mines.

Capitalized at $1.3 billion and with an annual production rate of nearly 850,000 tons of copper, Codelco-Chile is now the world's largest copper-mining company. Decree Law No. 1350 also established the new Comisión Chilena del Cobre under the Ministry of Mines to serve as a supervisory organization to direct copper development, marketing, and trade and to represent Chilean copper policy at international meetings. The Comisión will advise the Committee on Foreign Investment of new copper investments and will supervise the performance of foreign contractors. Through the restructured Centro de Investigación Minera y Metalúrgica (CIMM) the Comisión was also given the responsibility for promoting geological studies and mining and metallurgical research and development and for training technical and administrative personnel for the copper industry.

A new Chilean Nuclear Energy Commission was established by Decree Law No. 1557 of September 16, 1976.[3] The Commission will be an exclusive dependency of the President and will coordinate with the Government through the Ministry of Mining. The law designates the Commission as the sole agency responsible for the exploration, exploitation, and processing of natural atomic materials; "commercializing" all atomic materials extracted; and stockpiling all materials of nuclear interest. The Commission will negotiate operations contracts with private Chilean or foreign firms to conduct most of its activities. The new law specifies contractors' responsibilities, incentives, and obligations and includes terms for possible future State expropriation of private contractor operations.

The ninth annual Ministerial Conference of the Conseil Intergouvernmental des Pays Exportateurs de Cuivre (CIPEC) (Intergovernmental Council of Copper Exporting Countries) was hosted by Chile in Santiago in December 1976, during which the Chilean Minister of Mines was appointed Chairman of CIPEC for 1977. With Chile playing an important policymaking role at the conference, CIPEC expressed its continued concern over the gravity of the world economic and monetary climate as it affected current world copper market prices and the future of recent copper developments. The Ministers voted to continue support of the United Nations Conference on Trade and Development (UNCTAD) copper producer-consumer dialogue seeking a solution to these problems. An extraordinary session was to be called in early 1977 to discuss possible interim measures for stabilizing copper prices while awaiting agreement on other long-term solutions. In other policy action, CIPEC announced that it would increase support of existing national copper development centers, including granting of interim financial assistance to help the centers defend markets and develop new copper uses.

PRODUCTION

Buoyed by the termination of the CIPEC 15% copper production cutback agreement in July and by both increased copper prices and demand, Chilean production of copper and its major byproducts, molybdenum and silver, reached record highs in 1976, each increasing approximately 20%. Smelter and refinery output of copper each increased 18%. Combined iron and steel output increased 2%. With the exception of an 11% increase in marketed natural gas and an 83% rise in vanadium, production of all other significant minerals and fuels decreased in 1976. Total output of crude fertilizer materials decreased 14% despite an 82% increase in potassium nitrate production. Iron ore and petroleum production each decreased 6%, iodine 27%, and coal 14%.

[3] Bureau of Mines. Organization of the Chilean Nuclear Energy Commission. Mineral Trade Notes, v. 74, No. 3, March 1977, pp. 16–35.

Table 1.—Chile: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Copper:			
Mine output, metal content [2]	902,100	828,300	1,005,200
Metal:			
Smelter [3]	724,300	724,400	856,300
Refined: [4]			
Fire refined	112,200	125,300	141,700
Electrolytic	425,900	409,900	490,300
Gold, mine output, metal content, troy ounces	118,829	130,651	129,143
Iron and steel:			
Ore and concentrate, thousand tons	10,292	11,007	10,389
Pig iron, do.	[r] 516	417	403
Ferroalloys, do.	15	19	14
Crude steel [5], do.	635	490	480
Semimanufactures (hot-rolled), do.	[r] 481	284	342
Lead, mine output, metal content	420	309	1,816
Manganese ore and concentrate	28,695	20,016	28,639
Mercury, 76-pound flasks	921	97	13
Molybdenum, mine output, metal content	9,757	9,091	10,899
Selenium, kilograms	[e] 18,000	11,819	15,041
Silver, thousand troy ounces	6,646	6,263	7,287
Vanadium, mine output, metal content [e]	580	600	1,100
Zinc, mine output, metal content	3,349	3,174	5,056
NONMETALS			
Barite	4,194	5,982	17,123
Borates, crude, natural	968	--	3,202
Cement, hydraulic, thousand tons	1,425	1,014	963
Clays:			
Kaolin	74,979	59,532	66,735
Other (unspecified)	152,632	42,099	15,627
Diatomite	2,290	186	330
Feldspar	2,806	382	96
Fertilizer materials, crude:			
Nitrates:			
Sodium	664,185	656,250	491,415
Potassium, enriched	74,615	[e] 70,000	127,565
Phosphates, guano	18,600	13,579	16,107
Gem stones, lapis lazuli, kilograms	--	1,700	NA
Gypsum:			
Crude	135,111	139,429	65,079
Calcined	59,631	41,463	55,692
Iodine, elemental	2,273	1,962	1,424
Kyanite and related materials, andalusite	5,447	NA	NA
Pigments, natural mineral, iron oxides	16,482	9,805	6,941
Pumice (includes pozzolana)	176,741	[e] 150,000	98,681
Quartz:			
Common quartz	202,624	115,838	156,011
Glass sand		2,268	4,995
Salt, all types, thousand tons	239	299	428
Sodium sulfate [6]	41,384	34,592	40,791
Stone:			
Limestone, do.	2,596	1,518	1,723
Marble	497	399	3,739
Sulfur:			
Native, other than Frasch:			
Refined	7,528	4,940	16,334
Caliche	24,672	16,411	1,428
Byproduct (from industrial gases)	23,310	26,052	29,187
Total	55,510	47,403	46,949
Talc	1,684	475	129
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous and lignite, thousand tons	1,520	1,483	1,272
Coke:			
Coke oven, do.	303	211	214
Gashouse, do.	--	5	[e] 5
Gas, natural:			
Gross, million cubic feet	248,687	250,625	248,332
Marketed, do.	127,503	128,278	141,858
Natural gas liquids:			
Condensate, thousand 42-gallon barrels	850	712	686
Natural gasoline, do.	1,112	984	918
Liquefied petroleum gas, do.	3,038	2,986	2,887
Total, do.	5,000	4,682	4,491

See footnotes at end of table.

Table 1.—Chile: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
MINERAL FUELS AND RELATED MATERIALS—Continued				
Petroleum:				
Crude	thousand 42-gallon barrels	10,055	8,946	8,372
Refinery products:				
Gasoline:				
Aviation	do	172	107	75
Motor	do	9,196	7,742	8,091
Jet fuel	do	874	734	937
Kerosine	do	3,324	2,499	2,843
Distillate fuel oil	do	6,633	6,570	6,386
Residual fuel oil	do	11,177	7,696	7,712
Other:				
Liquefied petroleum gas	do	5,520	5,224	3,925
Naphtha	do	509	448	522
Asphalt	do	66	39	57
Unspecified	do	711	625	782
Refinery fuel and losses	do	134	100	1,251
Total	do	38,316	31,784	32,581

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, lime and pyrites are also produced, but available information is inadequate to make reliable estimates of output levels.

[2] Data given are the nonduplicative copper contents of ore, concentrate, precipitate, metal, and other copper-bearing products measured at the lowest stage of processing, as reported in available sources.

[3] Data given are total blister and equivalent copper output, including blister subsequently refined in Chile and copper produced by electrowinning.

[4] Data given are total refined copper output, distributed into 2 classes according to method of refining.

[5] Excludes castings.

[6] Includes natural sodium sulfate and anhydrous sodium sulfate, coproducts of the nitrate industry.

TRADE

Chile showed a favorable trade balance for the third consecutive year, with a 1976 surplus of over $400 million. The surplus reflects the success of a Government policy to reduce nonessential imports and to expand nonmineral exports such as timber. Copper accounted for $1.25 billion or 60% of the $2.1 billion value of all exports. In the past, copper has provided 75% to 80% of all export earnings. The reduced relative earning power of copper is attributed, in part, to the drop in the average international price of copper from $0.93 per pound in 1974 to $0.64 per pound in 1976. At a production level of 1 million tons of copper, this price difference represents an annual loss of nearly $600 million.

The other major mineral export earners in 1976 were iron ore, $88.6 million; nitrates and iodine, $41.3 million; and molybdenum, $33.1 million.

Chile's economic recovery during the year, which led to increased petroleum demand along with the decline of domestic petroleum production, continued to cause a drain on foreign exchange revenues. The $324 million value of petroleum imports represented 19% of all imported goods, and coal and coke imports accounted for an additional $11 million. Petroleum imports totaling 23.9 million barrels were purchased from Iran (34%), Venezuela (25%), Ecuador (21%), Gabon (15%), and Iraq (5%).

West Germany and Brazil were the biggest consumers of Chilean copper exports, receiving 19% and 15%, respectively, of the 982,000 tons of copper shipped. The United States and Japan followed with 10% each, and the United Kingdom was next with 9%. Over one-half of all copper exports went to Western Europe.

Approximately one-third of the nitrate output was used domestically as fertilizer, and 300,000 tons of sodium nitrate, valued at $20.6 million, and 80,400 tons of potassium nitrate, valued at $9.6 million, were exported.

Table 2.—Chile: Exports of copper and iron ore
(Metric tons unless otherwise specified)

Commodity and destination	1974	1975	1976
Copper ore and concentrate, Cu content:			
Canada	26,900	--	5,700
Germany, West	18,200	15,000	22,400
Japan	58,600	54,700	57,700
Korea, Republic of	3,800	5,800	9,200
Spain	6,900	12,900	24,700
Taiwan	--	2,000	2,100
Other	41,500	13,400	34,400
Total	155,900	103,800	156,200
Blister copper:			
China, People's Republic of	25,500	8,000	22,900
Germany, West	23,100	53,000	83,200
Japan	16,300	--	9,200
Spain	1,600	15,000	18,000
United Kingdom	33,500	38,800	30,100
United States	61,600	26,500	35,600
Yugoslavia	14,200	10,500	12,700
Other	38,700	28,000	19,300
Total	214,500	179,800	231,000
Refined copper:			
Argentina	37,300	36,700	19,000
Belgium	3,000	8,400	27,200
Brazil	41,500	45,400	143,200
France	34,700	45,000	41,700
Germany, East	10,800	18,000	11,000
Germany, West	86,300	102,700	84,700
Italy	63,000	55,700	71,300
Japan	50,600	32,100	32,200
Sweden	14,300	21,300	12,500
United Kingdom	53,600	66,100	56,000
United States	44,100	26,900	63,600
Other	48,600	45,900	32,300
Total	487,800	504,200	594,700
Iron ore, gross weight:			
Argentina thousand tons	67	415	112
Belgium do	209	--	615
Germany, West do	--	--	216
Japan do	8,548	8,712	7,476
Netherlands do	57	--	--
United States do	200	953	518
Total do	9,081	10,080	8,937

COMMODITY REVIEW

METALS

Copper.—In attaining its highest mine production on record, Chile increased its production 21% to 1,005,200 tons of copper. As shown in table 3, production was up at all mines except the Andina and Empresa Nacional de Minería (ENAMI) mines. Mine production exceeded reported capacity at Chuquicamata, suggesting that Codelco-Chile was mining a higher-than-average grade of ore during the year. The average grade of proven ore reserves at Chuquicamata is 1.38% copper.

Minera Sagasca, S.A., controlled 59% by Continental Copper & Steel Industries Inc., operated at 50% of capacity for the year and produced 11,400 tons of cement copper. The company, despite a $4 million partial writedown of investment, continued a $3.6 million improvement project to increase recovery efficiency and to increase production to 80% of capacity by mid-1977.

Production of blister copper at Chile's six smelters increased 18% to 856,300 tons. Electrolytic and fire-refined copper output also increased 18% to 632,000 tons. Codelco-Chile invested over $110 million during the year to replace equipment and improve operating efficiency. Major improvements included enlargement of the Chuquicamata smelter to a capacity of 4,000 tons of feed per day, installation of the new Sapos reservoir and the Coya-to-Colon water supply

Table 3.—Chile: Copper mine production (copper content)
(Metric tons)

Sector and mine	1975	1976	Percent change
Codelco-Chile: [1]			
Chuquicamata	r 304,600	445,500	+46
El Salvador	r 81,300	82,700	+2
El Teniente	r 234,000	261,700	+12
Andina	62,400	56,900	−9
Total	r 682,300	846,800	+24
Medium and small mines:			
Mantos Blancos	r 29,200	30,100	+3
ENAMI [2]	r 77,600	74,300	−4
Disputada	r 32,600	35,700	+10
Other	r 6,600	18,300	+177
Total	r 146,000	158,400	+8
Grand total	828,300	1,005,200	+21

r Revised.
[1] Corporación Nacional del Cobre de Chile.
[2] Empresa Nacional de Minería.

Source: Comisión Chilena del Cobre (Santiago). Producción y Exportaciones Chilenas de Cobre, 1971–76. February 1977.

system, and installation of a new tailings pond at El Teniente. Engineering plans were completed to update mine and mill systems at El Teniente to handle the harder, lower grade ore as mining moves into the deeper primary copper sulfide portion of the ore body.

At El Salvador, work began on the modernization of all old production facilities from mine through refinery, scheduled to be completed between 1977 and 1981. At Andina, work continued on a project to increase mine and mill capacity to 15,400 tons of ore per day.

Iron Ore.—Production of iron ore decreased 6% from the record high 11-million-ton output of 1975. Production was decreased to reduce the buildup of port stockpile and to bring production more in line with 1976 export shipments of 9,669,000 tons.

El Romeral, operating at full capacity, produced 4.1 million tons of ore in 1976, the highest output in its 21-year history. Its current reserves are estimated at 65 million tons of magnetic ore. El Algarrobo's open pit production decreased 15% to 2.4 million tons in 1976. The high phosphorus content of the ore and the irregular ore grade distribution continued to present mining and recovery problems. El Algarrobo's reserves are estimated at 70 million tons of primarily hematitic ore. Total output of the Santa Fe mine was down 16% in 1976 to 3.4 million tons. Santa Fe's reserves are estimated at 27 million tons, distributed among a group of smaller ore bodies divided into four districts (Incahuasi, Vallenar, Copiapó, and Caldera).

Shipments of iron ore by Cía. de Acero del Pacífico, S.A. (CAP), shown in table 4, decreased for each of the three mining divisions. Shipments to Japan were 470,939 tons less than those of 1975 but still represented 78% of the 9.7 million tons of ore exported. Shipments to the United States decreased 55%, and deliveries to the Hauchipato steel complex for domestic consumption were up 10% in 1976.

With $183 million of the expected total cost of $250 million spent by yearend, the Huasco Valley project was well on its way to meeting a late 1977 startup date. The project is composed of three major elements: The El Algarrobo concentration plant, the Huasco pellet plant, and the Guacolda Port pellet storage and shiploading facilities. The concentration plant is scheduled for completion in July 1977 at an annual capacity of 4.2 million tons of preconcentrate. The pellet plant, located 50 kilometers southwest of El Algarrobo, will have an initial capacity of 3,850,000 tons per year, with plans to double this capacity in the future. At this plant, 60% iron preconcentrates will be mixed with lime hydrate and bentonite and kiln-fired to produce ½-inch-diameter pellets containing 66% iron with maximum impurity levels of 0.05% phosphorus, 0.039% sulfur, and

3.5% silica. At Guacolda Port, construction is underway on two storage areas capable of holding 135,000 tons each of preconcentrates or pellets. The port will be able to handle ships of up to 150,000 deadweight tons. It is hoped that the additional pelletizing capabilities will help in the development of over 500 million tons of previously nonexportable ore in the Huasco Valley area. These future reserves are distributed among the El Algarrobo, Boqueron Chanor, Los Colorados, Domeyko II, Cristales, and other ore bodies.

Table 4.—Chile: Iron ore shipments by CAP[1] in 1976

(Thousand metric tons)

Division and product	Quantity
El Romeral:	
Blast furnace ore to West Germany	108
Blast furnace ore to Japan	1,163
Blast furnace ore to Argentina	112
Blast furnace ore to Huachipato steelmill	709
Fines to Japan	1,391
Fines to West Germany	108
Total	3,591
Santa Fe:	
Run-of-mine ore to Japan	2,198
Run-of-mine ore to Belgium	306
Run-of-mine ore to United States	429
Fines to Belgium	309
Fines to Japan	171
Open-hearth furnace ore to Huachipato steelmill	23
Total	3,436
El Algarrobo:	
Blast furnace ore to Japan	1,594
Fines to Japan	1,048
Total	2,642
Total shipments, by destination:	
Japan	7,565
United States	429
Europe	831
Argentina	112
Huachipato steelmill	732
Total	9,669

[1] Cía. de Acero del Pacífico, S.A.

Source: Skillings' Mining Review. V. 66, No. 8, Feb. 19, 1977, p. 33. (Original data in long tons, converted at a rate of 1 long ton=1.01605 metric tons.)

Iron and Steel.—Increased domestic demand failed to offset weak international export markets, and CAP continued to operate at reduced capacity, with iron and steel output for 1976 at about the same level as in 1975. In 1976, CAP produced 403,000 tons of pig iron, 448,000 tons of steel ingots, 342,000 tons of semifinished steel products, and 307,000 tons of finished products. Despite its current operating losses and the capital requirements of the Huasco Valley project, CAP continued to spend approximately $18 million per year to expand, maintain, and modernize its Hauchipato steel complex. The relining and hearth expansion of one of the complex's two blast furnaces was completed in August. In July, after 25 years of continuous operation, most of the company's 70 coking ovens were shut down to undergo a $7 million, yearlong renovation, during which CAP is importing coke from Japan. The year also saw the startup of a new water purification plant, a burnt lime plant, and fuel-saving Linz-Donawitz or basic oxygen process converters. The converters raised the Huachipato plant's capacity from 650,000 tons to 1 million tons per year at a cost of $65 million. Space was also allowed for a third converter to eventually increase capacity to 2 million tons per year.

Molybdenum.—Chile maintained its position as the world's third largest molybdenum producer, following the United States and Canada. Production increased to 10,899 tons, a 20% increase over that of 1975.

As part of a major expansion plan to produce 15,000 tons of molybdenum per year in Chile by 1980, Codelco-Chile brought in the first full year of production at its new 10,900-ton-per-year molybdenum recovery plant at Chuquicamata, and in October began production at the new 500-ton-per-year molybdenite recovery plant at Andina. Chile possesses 28% of the world's reserves of molybdenum, including approximately 2.5 million tons each of proven and indicated reserves. The major portion of the molybdenum reserves are found in association with the world's two largest copper mines, El Teniente and Chuquicamata.

Precious Metals.—Production of gold remained constant in 1976 at 129,143 troy ounces (46% from gold ores, 1% from silver ores, and 53% as a byproduct of copper production).

Domestic silver production increased 16% to a record high of 7.3 million troy ounces. Copper byproduct production accounted for 93.6% of silver output, silver and gold ores 4.9%, and lead and zinc byproduct production 1.6%.

NONMETALS

Iodine.—The State-owned Sociedad Quimeca y Minera de Chile (Soquimich), one of the world's three largest producers of iodine, continued a decreasing production trend from a high of 2,822 tons in 1970 to 1,424 tons in 1976.

Lithium.—Chile possesses approximately 1,270,000 tons of lithium, representing 64% of known world reserves. The lithium is found in the potassium-rich brines of the Salar de Atacama, 280 miles from Antofagasta in northern Chile. Foote Mineral Co. of the United States had been exploring the deposits for the past 2 years and at yearend was negotiating their potential development with the Chilean Government. Lithium is used in the production of primary aluminum, ceramics and glass, greases, fluxes, and air-conditioning equipment.

Nitrates.—In 1976, sodium nitrate production decreased 25% to 491,415 tons, while enriched potassium nitrate output increased 82% to 127,565 tons. The nitrate industry was facing a number of problems resulting in annual losses of $20 million. The downward trend of Soquimich's sodium nitrate and iodine production is attributed to the continued use of antiquated, labor-intensive extraction and processing systems. Chile has opted to keep the three older northern plants at Pedro de Valdivia, Maria Elena, and Victoria in operation to maintain the local employment levels at 9,000 persons, realizing that a new modern plant would match present total output but would employ only 300 to 400 persons.

MINERAL FUELS

Coal.—The State-owned coal company Empresa Nacional del Carbon (ENACAR) produced 1,272,000 tons of coal in 1976, with 44% coming from the Lota mine, 29% from the Schwager mine, and 27% from Minas Arauco. The 14% decrease in production was attributed by ENACAR partly to reduced worker productivity and partly to a methane fire that forced the closure of the District 5 South section of Schwager in September. Domestic coal sales increased 21% to 1,113,000 tons, with over 50% going for electricity and steel production. Chile exports small quantities of coal, primarily to Bolivia which imports about 1,000 tons per year. Coal imports dropped 17% to 134,580 tons. CAP imported virtually all of this coal for its specialty steels production.

ENACAR continued to encourage the substitution of coal for petroleum, estimating that annual demand for domestic coal could be increased by 462,000 tons. Since 1975, two copper refineries have converted their source of fuel from petroleum to coal. The copper industry is the largest end user of coal for electric power generation. ENACAR is also assisting other industries in preparing conversion plans.

ENACAR plans to expand annual production to 2.7 million tons by 1982; however, the lack of adequate financing may delay these plans. Chile estimates its current coal reserves at 5.5 billion tons, 90% of which are located in Magallanes Province in the far south of Chile, which accounts for less than 1% of current production. Proven reserves in the main producing fields of the Concepción-Arauco area total only 54 million tons. The Magallanes coal is high-ash, low-sulfur subbituminous coal. It is unsuitable for coking but may be used for electric power generation.

Petroleum and Natural Gas.—Crude oil production continued to decline, decreasing more than 6% to 8.4 million barrels. In response to improved economic growth, crude oil imports increased from 19.8 million barrels in 1975 to 23.9 million barrels in 1976 at a cost of $324.2 million, a 34% cost increase.

As part of Government policy to increase Chile's energy independence by intensifying the search for new petroleum resources, Empresa Nacional del Petróleo (ENAP) encountered increasing success in its oil exploration program in 1976. ENAP leased a large offshore drilling platform, the *Nugget*, from the U.S. firm Diamond M Drilling Co. to begin exploratory drilling in the Strait of Magellan. Between September and December 1976, four of the five *Nugget* holes in the Strait struck oil or gas, significantly increasing known reserves. At yearend, ENAP estimated proven reserves to be 51.3 million barrels of crude petroleum and 384.4 million petroleum-equivalent barrels (2.1 trillion cubic feet) of natural gas. Its probable reserves were estimated at 175.3 million barrels of crude petroleum and 409.1 million petroleum-equivalent barrels

(2.2 trillion cubic feet) of natural gas.[4 5] The majority of the reserves are located in Magallanes Province.

Of the 8.4 million barrels of crude petroleum produced, 56% was from mainland wells and 44% was from the island of Tierra del Fuego. Of the 248.3 billion cubic feet of natural gas produced, 43% was reinjected.

Geophysical and geological exploration continued in both the south-central zone and Magallanes Province; however, all of the 64 holes and 148,000 meters of total length drilled onshore in 1976 were located in Magallanes Province. The following tabulation gives the number of well completions:

Type of well	Petroleum	Natural gas	Dry	Total
1975:				
Exploration	--	2	20	22
Extension	--	1	5	6
Development	12	3	22	37
Total	12	6	47	65
1976:				
Exploration	4	1	17	22
Extension	1	--	8	9
Development	16	4	13	33
Total	21	5	38	64

Cumulative records of the drilling history in Magallanes Province to the end of 1976 show that of 1,700 holes drilled, 37% have located oil, 15% have located gas, and 48% have been dry.

Gasoline plants at Manantiales and Cullen on Tierra del Fuego and Posesión-Cabo Negro on the mainland processed 156.4 billion cubic feet of natural gas, stabilized 3.4 million barrels of crude petroleum, and refined 355,000 barrels of petroleum. During 1976, the refineries at Concón and Concepción processed a combined total of 32.4 million barrels of crude petroleum, 9% less than in 1975. The crude oil processed was supplied 23% from domestic sources and 77% from imports. The refineries operated at about 70% of capacity owing to extended maintenance downtime in the third and fourth quarters.

At Lirquen, work continued on new terminal facilities to receive tankers of up to 100,000 deadweight tons and on storage facilities for 664,000 barrels for the refinery at Concepción. A new plant was completed near Cabo Negro to build permanent drilling platforms for operations in the Strait of Magellan.

Chile was negotiating a major petroleum agreement with Atlantic Richfield Co. (Arco). Arco was interested in exploration and possible production of petroleum in a Pacific offshore area in southern Chile, near Chiloe Island between Chacao Canal and the Gulf of Penas. The total project cost is estimated at as much as $1 billion. The agreement was being negotiated as an operations contract under the terms of the 1975 Decree Law No. 1089 which reserves the ownership of hydrocarbon resources for the Government.

Difficulties in obtaining the necessary capital and in arranging long term gas sales contracts have forced ENAP to delay construction of the $320 million gas liquefaction plant at Cabo Negro.

Petroleum production, by field, for 1975 and 1976 was as follows, in thousand barrels:

Field	1975	1976
Daniel	1,485	1,136
Daniel Este	1,261	1,065
Calafate	1,153	1,044
Cullen	699	733
Posesión	717	685
Cañadón	601	569
Tres Lagos	625	566
Other	r 2,405	2,574
Total	r 8,946	8,372

r Revised.

Source: Empresa Nacional del Petróleo. Boletín Estadistico, 3er. y 4°. Trimestre y Anual 1976. V. 72, 1976, p. 6.

[4] Empresa Nacional del Petróleo. 1976 Annual Report (Memoria y Balance).

[5] Conversion factors used were 1 cubic meter=6.28981 42-gallon barrels of crude oil and 1 42-gallon barrel of crude oil=5,430 cubic feet of natural gas at 1,031 Btu per cubic foot.

The Mineral Indutry of the People's Republic of China

By K. P. Wang [1]

The economy of the People's Republic of China gave a lackluster performance in 1976. China's gross national product (GNP) was estimated at $280 billion to $290 billion.[2] Mineral production (excluding fuels) was significant in the overall scene, contributing approximately 10% of the 1976 GNP. Most analysts estimate that the GNP rose only 3%, about one-half of the 1975 increase. Industrial output increased a maximum of 5%, following 1975's estimated growth of 10%. Production of food grains registered an increase of 1% to 2% at most, barely keeping pace with population growth.

The fifth 5-year plan, originally scheduled to start in January 1976, was moved back at least 1 year, but Premier Chou En-Lai's announced goals of "achieving relative modernization of industry and agriculture by 1980 and making China a powerful modern socialist country by the end of the century" apparently still stood despite the Premier's death on January 8. Major programs to mechanize farming and raise industrial production 15% annually were initiated at yearend. The plan was to build up an independent nationwide industrial and economic system during 1976–85. Oil consumption continued to increase as more supplies became available—a significant development in China's economic progress.

Political uncertainties slowed down production somewhat and decreased equipment purchases considerably in 1976. In absolute terms, output of basic industrial products continued to increase although growth rates went down in this year of tense circumstances. Total trade volume may not have changed too much from 1975's $14 billion, but imports of equipment and industrial products clearly declined. Petroleum, an important foreign exchange earner, showed a decline in exports to market economy countries, despite a significant gain in overall output. The Minister of Foreign Trade, Li Chiang, told Peking visitors near yearend that China would resume large-scale foreign trade, particularly purchases of entire plants, in 1978.[3]

There was a series of major earthquakes in 1976. The first occurred in western Yunnan Province near the Burmese border around July 5. Like its predecessor 17 months earlier in southern Liaoning Province (Manchuria region)—China's first serious earthquake in the 20th century—the Yunnan upheaval was predicted by seismologists, and damage to human life and industry was minimal. The Tangshan earthquake on July 27–28 was 8.2 on the Richter scale and killed perhaps 650,000 people, injuring a like number. Upheaving in the heartland of northern China's industrial area within the confines of the country's largest coal combine and near the Takang oilfield, this earthquake was expected but the date had not been predicted. There was another severe earthquake west of Ch'engtu in the southwest around August 15, which was accurately predicted and therefore caused minimal loss of life.

[1] Supervisory physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Chinese Ren-Min-Bi (RMB) to U.S. dollars at the nominal exchange rate of RMB1.9=US$1.00.

[3] New York Times. Oct. 28, 1976, p. 10.

Around November 15, the Tangshan tremors moved closer to Peking and Tientsin, with two quakes of more than 7 on the Richter scale at the epicenters and 4 at Peking. The Chinese had expected these and have not talked much about their aftermath.

The year 1976 was one of slower economic growth, marked by slight gains in most mineral industries and setbacks in a few. The overall transportation system was in difficulty because of the slowdown brought about by political activities and the aftermath of the earthquakes. The petroleum industry continued to make notable gains, with the main field Taching showing signs of production maturity and a new field reported near Chinchou. The oil refining and petrochemicals industries did well, but construction of pipeline and distribution facilities lagged. Production and use of natural gas made significant gains, and Szechwan gas had been piped halfway to Shanghai. The coal industry suffered the earthquake catastrophe in northern China but did well in all other areas, particularly in the south. The steel industry had considerable difficulty, caused mainly by the curtailment of Kailan's coking coal output and political problems at the Wuhan steelworks. The cement and fertilizer industries continued to expand, and one-half of the ammonia plants being constructed by Kellogg Co. were completed.

The Chinese Academy of Sciences announced on January 4, 1977, that three geological maps of considerable significance were about to be published.[4] The 1:4,000,000-scale tectonic map shows in detail China's three systems of geological structures, with information on their genesis, development, and interrelationships. The 1:4,000,000-scale geological map of China shows the accomplishments of China's geological work since the founding of the People's Republic. Comprehensive geological surveys had been completed throughout most of the country, and this map was to be the first of its kind announced to the outside world. The 1:5,000,000-scale geological map of Asia is to be an extension of the geological map of China and includes tectonic information. The Chinese lauded the publication of these maps for breaking the monopoly of the United States and the U.S.S.R. in compiling world geological maps, and as a credit to China and the Third World at large.

Electric power output rose 6% to 8% in 1976. Between 1973 and 1975, eight powerplants costing over $200 million were imported from the West, indicating the emphasis in this area. China's capacity at just over 40 million kilowatts at yearend was still only one-tenth of the U.S. total. About 80% of Chinese electric power was thermal, mostly coal-fired, and the rest was hydroelectric. However, many new facilities based upon oil and gas were being built. Hydropower was also being pushed, particularly medium and small plants, with over 60,000 of these scattered throughout southern and southwestern China. Large thermal and hydropower plants were being built in strategic locations. The largest hydroelectric generator was 300,000 kilowatts, compared with 200,000 kilowatts for thermal units. The whole area of electric equipment manufacture and capability in power distribution was moving ahead rapidly, as evidenced by the fact that high-pressure transmission facilities of 500,000 volts were being trial-manufactured in Shenyang.[5] China had been buying large quantities of nonferrous metals abroad for its electric power industry. Abundant supplies of coal, oil and gas, and hydropower in widespread areas give Chinese policy planners important alternatives in developing energy resources. China was the world's fourth largest producer and consumer of energy, with coal accounting for about three-fourths of the total.

During 1976, China exploded four nuclear devices, all at Lop Nor, Sinkiang Uighur Autonomous Region, bringing the country's total to 21. The second blast was an H-bomb in the atmosphere, the third test was underground, and the fourth test was a 4-megaton hydrogen device in the atmosphere. China successfully launched its sixth and seventh satellites into orbit around the earth on August 30 and December 7, respectively. The latter was China's second satellite to be returned to earth without malfunction, the first being the fourth satellite launched on November 26, 1975.

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[4] New China News Agency (Peking). Jan. 4, 1977, p. 4.
[5] Takungpao (Peking). July 3, 1976, p. 1.

The Chinese have become very interested in nuclear power generation because of rapidly growing needs for electricity in industry. As early as October 1972, a Chinese industrial survey team composed mainly of power and nuclear specialists visited Japan to investigate Japanese know-how and seek possible technical ties. They also exchanged visits with the Canadians on the subject of electric power in 1973 and expressed an interest in nuclear power. Apparently, China does not intend to generate electricity from nuclear energy on a large scale until the 1980's.

PRODUCTION

China retained its position as the world's fifth largest mineral producer in 1976. The country's prominence as a leading world producer of anthracite, bituminous coal, antimony, salt, tin, and tungsten have been known for some time. In recent years, China has also achieved ranking among the top five producers of steel, cement, fluorspar, graphite, magnesite, nitrogenous fertilizer, phosphate rock, high-grade talc, and natural gas. Also of great importance was the fact that China has become one of the world's top 10 producers of petroleum, rare-earth elements, and rare and high-purity metals. China is not only one of the world's richest mineral areas but has also made significant headway in producing the necessary quantities of minerals and fuels for its expanding industrial economy.[6]

Despite the Kailan-Tangshan catastrophe and the fact that other large coal combines around the country came to the rescue at the expense of their own operations, the Chinese coal industry still registered a small gain in output. China's coal output, ranking a strong third after that of the United States and the U.S.S.R., was scheduled to be expanded sharply. Crude oil production reportedly rose 13% over that of 1975, and the annual output rate probably reached 100 million tons (or 2 million barrels per day) by midyear. Marketed output of natural gas reportedly increased 14% over that of 1975, and there is evidence that the Chinese were trying hard to fully utilize the additional production.

The steel industry had a poor year, with output declining 7% from the 1975 level. However, the situation looked much improved at yearend, and it appeared to be a matter of a few years before annual production would exceed 30 million tons. The cement industry continued to gain ground swiftly, spearheaded by the buildup of small- to medium-size local plants in southern China. Many felt that China's cement output had already surpassed that of any Western European country.

The well-known export metals such as tungsten, antimony, and tin appeared in lesser quantities in world markets than in 1975, but this did not mean that production was any less. China greatly improved its manufacturing position in both nitrogenous and phosphatic fertilizers, spurred in part by the growth in oil and gas use and the fact that the large new chemical fertilizer plants had not yet reached full production. The Chinese salt industry, which mainly utilized seawater, gained on the United States, the only larger salt producer than China. China remained prominent in production of nonmetals such as asbestos, barite, fluorspar, magnesite, pyrite, and talc.

[6] Wang, K. P. Mineral Resources and Basic Industries in the People's Republic of China. West View Press, Boulder, Colo., May 1977, 225 pp.

Table 1.—People's Republic of China: Estimated production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 p
METALS			
Aluminum:			
Bauxite, gross weight [2]	970,000	970,000	1,100,000
Alumina, gross weight	400,000	r 420,000	520,000
Metal, primary, refined	150,000	160,000	200,000
Antimony, mine output, metal content	12,000	12,000	12,000
Bismuth, mine output, metal content	250	250	250
Cadmium, smelter	110	110	110

See footnotes at end of table.

Table 1.—People's Republic of China: Estimated production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS—Continued			
Copper:			
Mine output, metal content	100,000	100,000	100,000
Metal, smelter	100,000	100,000	100,000
Metal, refined	150,000	150,000	150,000
Gold, mine output, metal content ——troy ounces	50,000	50,000	50,000
Iron and steel:			
Iron ore, gross weight [3] ——thousand tons	60,000	65,000	65,000
Pig iron and ferroalloys ——do	30,000	32,000	30,000
Crude steel ——do	27,000	29,000	27,000
Rolled steel ——do	[r] 21,000	[r] 22,000	20,000
Lead:			
Mine output, metal content	100,000	100,000	100,000
Metal, refined	100,000	100,000	100,000
Magnesium metal, primary	1,000	1,000	1,000
Manganese ore, gross weight ——thousand tons	1,000	1,000	1,000
Mercury, mine output, metal content ——76-pound flasks	26,000	26,000	26,000
Molybdenum, mine output, metal content	1,500	1,500	1,500
Silver, mine output, metal content ——thousand troy ounces	800	800	800
Tin:			
Mine output, metal content	20,000	22,000	20,000
Smelter	20,000	22,000	20,000
Tungsten, mine output, metal content	8,500	9,000	9,000
Zinc:			
Mine output, metal content	100,000	100,000	100,000
Refined	100,000	100,000	100,000
NONMETALS			
Asbestos	150,000	150,000	150,000
Barite	200,000	250,000	270,000
Cement, hydraulic ——thousand tons	25,000	30,000	35,000
Fertilizer materials:			
Natural:			
Phosphate rock ——do	3,000	3,400	3,400
Potash, marketable, K_2O equivalent [4] ——do	[r] 380	[r] 400	450
Manufactured, nitrogenous, N content [4] ——do	[r] 2,560	[r] 2,970	3,450
Fluorspar, metallurgical grade	300,000	350,000	350,000
Graphite	40,000	50,000	50,000
Gypsum ——thousand tons	[r] 800	[r] 900	1,000
Magnesite ——do	1,000	1,000	1,000
Pyrite, gross weight [5] ——do	2,000	2,000	2,000
Salt ——do	[r] 25,400	[r] 29,940	30,000
Sulfur:			
Native	[r] 130,000	[r] 130,000	150,000
Content of pyrite	900,000	900,000	900,000
Byproduct, all sources	120,000	120,000	320,000
MINERAL FUELS AND RELATED MATERIALS			
Coal:			
Anthracite ——thousand tons	20,000	20,000	20,000
Bituminous and lignite ——do	430,000	450,000	460,000
Total ——do	450,000	470,000	480,000
Coke, metallurgical ——do	28,000	28,000	28,000
Gas, natural:			
Gross production ——million cubic feet	1,400	1,600	1,800
Marketed production ——do	1,200	1,400	1,600
Petroleum:			
Crude (including that from oil shale) thousand 42-gallon barrels	474,500	571,590	645,897
Refinery products ——do	422,000	509,000	575,000

[p] Preliminary. [r] Revised.

[1] In addition to the commodities listed for which quantitative estimates of output have been made, the People's Republic of China is known or believed to have produced the following commodities for which no estimates, even of order of magnitude, have been prepared, owing to a paucity of general information upon which to base an estimate: Arsenic, chromite, nickel, titanium minerals, uranium, boron materials, various clays (including kaolin), lime, mica, various industrial and dimension stones, sand and gravel, and carbon black. Other unlisted commodities may also be produced.

[2] Diasporic bauxite; includes an estimated 160,000 tons annually of production for refractory applications.

[3] Iron content assumed to be 50%.

[4] Data are for years ending June 30 of that stated as reported in the British Sulphur Corp. Ltd. Statistical Supplement (London), No. 14, November-December 1976, pp. 18–19.

[5] Sulfur content of pyrite is reported under "Sulfur".

TRADE

China's total trade value remained at about $14 billion. Exports were up marginally from $6.9 billion (revised) in 1975, and imports were down somewhat from $7.2 billion (revised) in 1975. Purchases of complete industrial plants and nonferrous metals were considerably lower than in 1975, but steel imports increased slightly. Oil exports were a little lower, as were fertilizer imports. Reduced quantities of China's main export minerals were sold in the world market. Thus, overall mineral trade appeared to have been lower in 1976, compensated for, however, by more business in other areas.

Japan continued to be China's leading trading partner, but trade declined from $3.79 billion in 1975 to $3.03 billion in 1976. Imports from Japan fell 27.8% to $1.66 billion and exports to Japan fell 8.7% to $1.37 billion. Lower receipts of Japanese chemical fertilizers and machinery caused the decline in imports, whereas lower shipments to Japan of Chinese high-wax crude oil was the principal reason for the reduced exports. Crude oil exports to Japan declined from 8.1 million tons in 1975 to 6.8 million tons in 1976, whereas imports of Japanese steel increased from 2.9 million tons in 1975 to nearly 4 million tons in 1976. The Chinese were quite concerned over this double loss in foreign exchange and started to negotiate a long-term deal to increase sales to Japan of oil and coking coal to an estimated 10 million tons of oil and 5 million tons of coal per year within 5 years.

Trade between the United States and China remained small, although the potential is excellent. U.S. exports to China were $135 million in 1976, with aluminum worth $25 million, and U.S. imports from China were $200 million.

Table 2.—People's Republic of China: Apparent exports of selected mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite and concentrate	111,178	103,119	Italy 29,687; West Germany 15,801; France 15,315.
Oxide and hydroxide	2,250	2,300	All to Finland.
Antimony:			
Ore and concentrate	17	20	All to Zambia.
Metal including alloys, all forms	100	100	All to U.S.S.R.
Arsenic oxide and acids	969	976	Japan 457; Italy 436.
Chromium oxide and hydroxide	247	210	Finland 80; Sweden 60; Austria 50.
Copper metal including alloys, all forms	NA	262	Belgium-Luxembourg 165; Italy 97.
Iron and steel metal:			
Pig iron, ferroalloys, similar materials	560	241	Sweden 211.
Semimanufactures:			
Bars, rods, angles, shapes	NA	2,531	All to Zambia.
Wire	610	[2] 540	All to United States.
Tube, pipes, fittings	712	[2] 73	Belgium-Luxembourg 51; Zambia 22.
Other	NA	[2] 46	Zambia 27; West Germany 19.
Lead metal including alloys, all forms	58	25	All to United States.
Manganese:			
Ore and concentrate	61,273	48,022	Japan 44,959.
Oxide and hydroxide	1,812	2,987	Sweden 1,124; Finland 863; Norway 520.
Mercury 76-pound flasks	4,351	4,263	France 1,044; Poland 870; Australia 522.
Tin metal including alloys, all forms	9,159	11,337	United States 6,378; France 1,461; Netherlands 1,087.
Titanium oxides	490	[2] 216	All to Japan.
Tungsten ore and concentrate	8,073	5,398	U.S.S.R. 1,700; Sweden 861; Austria 735.
Zinc:			
Oxide and hydroxide	30	NA	
Metal including alloys, all forms	495	3,655	United Kingdom 1,195; Switzerland 1,085; Netherlands 482.

See footnotes at end of table.

Table 2.—People's Republic of China: Apparent exports of selected mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Other:			
Ores and concentrates, n.e.s.[3]	5,736	[2] 2,733	Japan 2,437.
Oxides, hydroxides, peroxides of metals, n.e.s	[2] 682	[2] 440	West Germany 149; United Kingdom 83; Sweden 67.
Metalloids	[2] 46	3	Canada 2; France 1.
Nonferrous metals including alloys, all forms, n.e.s	[2] 1,255	[2] 975	Japan 415; France 194; United Kingdom 190.
NONMETALS			
Abrasives, natural: Grinding and polishing wheels and stones	NA	[2] 4	All to Zambia.
Asbestos	1,394	1,384	Japan 1,204; Italy 180.
Barite and witherite	[2] 100,759	[2] 50,513	France 32,904; Japan 11,000.
Boron materials, oxide and acid	40	120	West Germany 100; Switzerland 20.
Cement, hydraulic	NA	440	All to Zambia.
Clays and clay products:			
Crude	112,909	80,602	Japan 71,034; Italy 4,531.
Products:			
Refractory	4,804	3,913	All to Japan.
Nonrefractory ____value, thousands__	$30	$28	All to Australia.
Cryolite and chiolite	1,197	5,221	United States 4,767; Canada 454.
Diamond:			
Gem, not set or strung _value, thousands__	$233	$840	Belgium-Luxembourg $529; Japan $281.
Industrial _____do____	$144	$2,106	All to Belgium-Luxembourg.
Feldspar and fluorspar:			
Fluorspar	102,985	74,879	U.S.S.R. 55,407; Poland 19,472.
Undifferentiated	210,752	120,165	Japan 107,611; Australia 8,154.
Fertilizer materials:			
Crude, phosphatic	860	9,258	Mainly to Australia.
Manufactured, nitrogenous	NA	233	All to Zambia.
Graphite, natural	11,936	10,867	West Germany 4,361; United States 2,268; France 1,887.
Magnesite	62,113	50,278	United Kingdom 16,365; West Germany 15,696.
Mica, crude	4,414	4,017	United Kingdom 2,062; West Germany 1,755.
Pigments, iron oxides	855	1,111	Japan 607; Italy 340; Denmark 164.
Precious and semiprecious stones, except diamond _____value, thousands__	$2,325	$424	All to West Germany.
Salt _____thousand tons__	[2] 101	[2] 100	All to U.S.S.R.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	10,813	10,940	All to Japan.
Worked	[2] 3,668	[2] 7,351	Japan 1,205; West Germany 749.
Gravel and crushed rock	4,843	2,610	Japan 2,390.
Quartz and quartzite	22,601	16,415	Japan 12,398; United Kingdom 2,062; West Germany 1,755.
Talc, steatite, soapstone, pyrophyllite	230,154	155,424	Japan 132,056; United Kingdom 12,536.
Other:			
Crude	3,701	2,924	Japan 1,099; Australia 897.
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture	9,003	5,500	All to Japan.
Oxides and hydroxides of magnesium, strontium, barium	2,732	[2] 2,058	Mainly to Finland.
MINERAL FUELS AND RELATED MATERIALS			
Coal	405,127	455,784	All to Japan.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels__	28,455	57,407	Do.
Refinery products:			
Lubricants _____value, thousands__	$207	$74	Australia $52.
Other:			
Mineral waxes thousand 42-gallon barrels__	286	10,439	Mainly to Zambia.
Petroleum coke _____do____	391	336	All to Japan.
Bitumen _____do____	NA	818	All to Zambia.

NA Not available.

[1] Compiled from import data of Australia, Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France, West Germany, Hungary, Italy, Japan, the Netherlands, New Zealand, Norway, Poland, Spain, Sweden, Switzerland, the U.S.S.R., the United Kingdom, the United States, Yugoslavia, and Zambia.

[2] Partial figure; tonnage not available for all destinations.

[3] Source does not give details on metals included in this category; presumably, the figure consists chiefly of antimony, bismuth, and molybdenum.

Table 3.—People's Republic of China: Apparent imports of selected mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Oxide and hydroxide	440	515	Denmark 256; West Germany 200; United States 59.
Metal including alloys:			
Unwrought	24,828	318,477	United States 62,510; Norway 50,157; France 48,121.
Semimanufactures	1,167	860	Japan 545; United States 223.
Copper metal including alloys, all forms	63,433	[2] 31,575	Zambia 17,774; Japan 10,393; Yugoslavia 3,000.
Iron and steel:			
Ore and concentrate ---thousand tons	1,581	1,436	Mainly from Australia.
Metal:			
Scrap ---do---	173	199	United States 159; Canada 40.
Pig iron, ferroalloys, similar materials ---do---	692	440	Australia 427; Yugoslavia 12.
Steel, primary forms ---do---	416	558	Japan 540; Italy 16.
Semimanufactures:			
Bars, rods, angles, shapes, sections ---do---	590	729	Japan 598; France 39; Spain 33.
Universals, plates, sheets ---do---	[2] 1,637	[2] 1,520	Japan 1,245; West Germany 105.
Hoop and strip ---do---	163	134	Japan 75; West Germany 28.
Rails and accessories ---do---	1	7	Mainly from Japan.
Wire ---do---	19	16	Japan 11; Belgium-Luxembourg 2.
Tubes, pipes, fittings ---do---	[2] 602	[2] 721	Japan 335; West Germany 308.
Castings and forgings, rough ---do---	([3])	([3])	All from France.
Other, finished rolled steel ---do---	37	41	All from Poland.
Total ---do---	3,049	3,168	
Lead:			
Oxide and hydroxide ---value, thousands---	$267	$202	All from Australia.
Metal including alloys, unwrought	3,097	23,793	Canada 14,498; Japan 9,295.
Magnesium metal including alloys, unwrought	51	18	All from West Germany.
Manganese:			
Ore	NA	60	All from Belgium-Luxembourg.
Oxides	782	787	All from Japan.
Nickel metal including alloys, all forms	[2] 21,725	[2] 524	Canada 500; United States 24.
Platinum-group metals including alloys, all forms ---value, thousands---	$3,558	$937	United Kingdom $828.
Silver metal including alloys ---do---	$245	$849	All from West Germany.
Tin oxide	6	5	Do.
Titanium oxide	1,620	2,208	Japan 2,083; Belgium-Luxembourg 125.
Tungsten metal including alloys, all forms	13	1	All from Japan.
Zinc metal including alloys, all forms	375	([4])	NA.
Other base metals	514	[2] 5	All from Japan.
NONMETALS			
Abrasives, natural: Grinding and polishing wheels and stones	3	[2] 9	Japan 8; West Germany 1.
Asbestos, crude	NA	160	All from Canada.
Clay products:			
Refractory	[2] 2,600	[2] 2,218	France 1,000; Japan 656.
Nonrefractory	108	37	All from West Germany.
Corundum, artificial	NA	92	All from United States.
Diamond:			
Gem, not set or strung ---value, thousands---	$3,500	$6,305	United Kingdom $5,600; Belgium-Luxembourg $705.
Industrial ---do---	$262	$2,577	All from Belgium-Luxembourg.
Fertilizer materials, manufactured:			
Nitrogenous ---thousand tons---	[r] 1,510	1,962	Japan 1,476; Netherlands 157; Poland 143.
Potassic ---do---	214	139	Canada 129; Belgium-Luxembourg 10.
Other, included mixed ---do---	73	25	Italy 11; West Germany 9; Japan 4.
Mica, worked	7	3	All from United Kingdom.
Precious and semiprecious stones, except diamond, natural ---value, thousands---	$503	$424	All from West Germany.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	NA	1,708	All from Italy.
Soda ash	2,000	2,150	All from Japan.
Sulfur, all forms	[r] 14,282	65,094	Mainly from Canada.
Other: Halogens (excluding chlorine)	81	[2] 10	All from Japan.

See footnotes at end of table.

Table 3.—People's Republic of China: Apparent imports of selected mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	700	2,070	Japan 1,931; United Kingdom 139.
Petroleum refinery products:			
Lubricants—thousand 42-gallon barrels	[2] 2	[2] 1	All from Italy.
Distillate fuel oil—do	18	6	All from Yugoslavia.
Residual fuel oil—do	25	6	Do.
Mineral jelly and wax—do	2	([3])	All from West Germany.
Nonchemical coal and petroleum wastes—do	NA	1	All from Japan.
Other—do	126	168	All from Poland.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	11,101	5,319	West Germany 4,472; Japan 847.

r Revised. NA Not available.

[1] Compiled from export data of Australia, Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France, West Germany, Hungary, Iceland, Italy, Japan, the Netherlands, New Zealand, Norway, Poland, Spain, Sweden, Switzerland, the U.S.S.R., the United Kingdom, the United States and Puerto Rico, Yugoslavia, and Zambia.

[2] Partial figure; tonnage not available for all sources.

[3] Less than ½ unit.

[4] Value only reported at $37,000.

COMMODITY REVIEW

METALS

Aluminum.—China apparently had not yet built a second large aluminum facility to complement the 20-year-old, 100,000-ton-per-year Fushun plant in southern Manchuria. The Fushun plant had 640 450-kilogram-per-day horizontal stud Soderberg cells in four potlines. Without connections with the international aluminum companies, the Chinese have not been able to increase production substantially. There were signs, however, that some firms may be interested in doing something in China, including Aluminum Co. of America (Alcoa). An aluminum plant with at least 100 cells had been mentioned for Sanmen Gorge, the site of a scaled-down hydroelectric irrigation project on the Honan-Shansi border. The Japanese said that there was another plant of 20,000- to 30,000-ton size at Lanchow, Kansu. In Yiliang County of Yunnan Province, about 80 kilometers southeast of K'unming, there was reportedly a new aluminum plant with two production lines. Other small plants may have been erected at Ch'angsha (Hunan), Wuhan (Hupeh), Taiyüan (Shansi), Tsingtao (Shantung), Hofei (Anhwei), Sian (Shensi), Changlin (Kirin), and several other places as well. Thus, total aluminum capacity appears to be more than 250,000 tons per year. The country's 1976 aluminum production was conservatively estimated at 200,000 tons, but it may have been considerably higher and prospects for somewhat expanded output within several years were good. The Nant'ing plant in Changtien, Shantung Province, remained the only known large alumina plant in China, and it had four big rotary kilns. A small alumina plant had recently been completed in Wench'ang County, Hainan Island, and there were undoubtedly many other similar plants around the country.

China's known aluminum resources were extensive but not of a particularly good grade. Total resources may be on the order of 1 billion tons, but known workable reserves were probably closer to 100 million tons. Most of the raw materials used consisted of high-silica diasporic bauxite from Shantung, aluminous shale from Liaoning, and alunite that had to be processed by the soda-lime sinter, calcium aluminate, and other non-Bayer processes. Promising bauxite resources, however, were said to occur in Kweiyang, Kweichow Province; around Pench'i, Liaoning Province; Hopeh Province; K'unming, Yunnan Province; and even in Honan, Chekiang, and Fukien Provinces and Kwangsi Chuang Autonomous Region. A limited number of good-grade bauxite deposits undoubtedly have been worked, although bauxite in general has

not been investigated enough for accurate appraisals. The Fushun plant uses about 500,000 tons of local aluminous shale annually for its aluminum raw material.

Demand for aluminum and copper has been increasing steadily in China as a result of expansion of power generation and transmission facilities. A further sharp rise in aluminum consumption was expected in view of the overall industrial activity to be created by higher levels of oil and gas production and consumption. Chinese imports of aluminum, which were low in 1974, shot up suddenly in 1975 under low-price conditions, then dropped to a new low in 1976 as prices rose. Swiss Aluminium Co. (Alusuisse), Péchiney Ugine Kuhlmann of France, Kaiser Aluminum & Chemical Corp. and Howmet Corp. of the United States, Mosal Aluminium A/S of Norway, and Aluminum Co. of Canada Ltd. (Alcan) all concluded large contracts with China during 1975, along with half a dozen other international firms for lesser tonnages. Actual shipments to China in 1975 included 62,510 tons from the United States, about 24,000 tons from the United Kingdom, 33,000 tons from Canada, 38,430 tons from Japan, 48,120 tons from France, and 50,160 tons from Norway. U.S. exports to China of unwrought aluminum in 1976 were 37,350 tons. Trade circles believe that China could buy up to 100,000 tons of aluminum in 1977. China seemed to be shopping around for good deals, vacillating between traditional and new suppliers.

Antimony.—China has traditionally produced antimony in various forms mainly for export, having excellent knowledge of this metal. In recent years, annual output of antimony has been in excess of 10,000 tons and was perhaps 12,000 tons in 1976, worth $35 million to $40 million. During World War I, China was by far the world's largest producer. However, the market for antimony for use in small arms and shrapnel shells vanished with the end of the war, although demand for use in batteries, bearings, type metal, solder, and standard munitions remained strong and consumption in flame proofing, pigments, and ceramics became stronger. The Republic of South Africa with its gold-antimony ores and Bolivia with its complex metals rivaled China in 1976 as leading antimony producers. The three countries met in La Paz late in 1975, and a Bolivian antimony delegation visited China in 1976 to discuss cooperation and exchange of information.

The bulk of Chinese antimony traditionally comes from the southwestern part of Hunan Province, led by the Hsik'uangshan mine, which alone may have more than 1 million tons of antimony reserves. Kwangtung Province ranked a distant second in potential reserves and output. Resources were so large and of sufficiently good grade that China could produce as much antimony as the world and Chinese markets could absorb. However, with only moderate prices ($1.50 per pound in mid-1976) and the small tonnages involved, the antimony business was not too attractive.

Measured by receipts of importing countries, Chinese exports of antimony have been declining since 1973. Japan's Hibino Metals Corp. was a major importer of 50% to 60% antimony concentrates at one time, but Japan as a whole took only 819 tons in 1976. The United States imported 1,170 tons of antimony oxide and 200 tons of metal in 1976, valued at about $4 million. China's own consumption of antimony may have been about 5,000 tons annually, although demand should have been rising. The Chinese undoubtedly had considerable antimony stockpiles.

Copper.—China's refined copper output was perhaps on the order of 150,000 tons in 1975 and 1976. Most of the raw material was domestic ore. However, local scrap was of some importance, and foreign concentrates were also imported. The country still did not have one really big copper facility, and there was no evidence that any operating copper mine had more than 15,000 to 20,000 tons per year of capacity. The Hungtoushanching mine near Fushan, Liaoning, may have been producing about 3,000 tons of 1.2% copper (plus 1% zinc) ore per day. The Huatung copper mine at Ch'ingyüan, Liaoning, recently installed a new flotation unit to greatly increase beneficiation capacity. The T'unghua mine in Kirin Province was expanded and diversified to yield possibly 4,000 tons per year of mine copper. The T'ungkuanshan copper mine in Anhwei Province may have been producing 300,000 tons per year of 2% copper ore. Fushan and Yashan were newly developed copper mines in Shantung Province. There was no news on the relatively large

Tungch'uan mine in Yunnan Province, but the "No. 3 metal mine" in Yunnan (very possibly Tungch'uan) had an aerial tramway installed in the early 1970's.

Porphyry copper was identified somewhere in the Ch'ilien Mountains of Kansu Province and the Chungt'iao Mountains of Shansi Province, and Chekiang Province may have a 1% copper ore body 3 kilometers long. Apparently, none of these so-called large deposits has been developed, probably because of the great concentration of capital, technology, and effort needed. An open pit copper mine mentioned for Tayeh, Hupeh Province, called Tunglüshan is of archeological as well as commercial interest, because old underground workings and tools found have been identified as being of the "Chunchiu-Chankuo" period more than 2,000 years ago. The original ore body was about 2 kilometers long and 1 kilometer wide, with 400,000 tons of smelting slags lying around native copper-malachite-chrysocolla minerals. Considerable excavation for relics has been done.

Because of electric power and machinery requirements, China's copper consumption has risen steadily and probably exceeded 300,000 tons during 1975 and 1976. Most of the shortage has been met by imports of refined copper, although foreign concentrates have recently come into the picture. Except for those at Shenyang and Shanghai, little was known about Chinese nonferrous smelters. The Shenyang smelter produced several tens of thousands of tons of copper per year, along with refined lead and zinc. That at Shanghai primarily used imported blister copper and local scrap as copper raw materials, and its capacities in copper and lead were both a little larger than those of the Shenyang smelter. Apparently, relatively new nonferrous smelters have been built at Lanchow in Kansu Province and Urumchi in Sinkiang Uighur Autonomous Region. Copper refineries of undetermined size have also been mentioned for Taiyüan, Wuhan, and K'unming; Anhwei Province; and Hainan Island. Chinese discussions with Japanese firms such as Sumitomo Metal Mining Co., Ltd., Furukawa Mining Co., Ltd., and Mitsubishi Metal Corp. about flash and continuous smelters have not led to anything specific.

China handed over the 1,100-mile, $250 million Tanzam Railway to the Presidents of Tanzania and Zambia on July 15, 1976, with the Presidents of Zaire and Botswana attending the ceremonies as well. This could very well mean that China will be getting more copper from Africa in the future. A long-term contract with Zambia called for the purchase of 50,000 tons of copper annually, and large quantities might eventually be purchased from Zaire also. Chile may have sold China over 30,000 tons of copper in 1976; actual exports of copper by Chile to China were 55,500 tons in 1973 and 40,800 tons in 1974. The Chileans were talking about renegotiating a large 3- to 5-year Chinese loan contract to be repaid by Chilean copper, nitrates, and iodine. An understanding with Peru was still in effect for approximately 40,000 tons of copper annually, plus 10,000 tons each of lead and zinc, in exchange for help in developing the Tintaya copper deposit in Peru.

There was no known followup on receiving copper concentrates from Bougainville after an initial trial shipment of 10,000 tons of concentrates to China in late 1975. Philex Mining Corp. and Atlas Consolidated Mining and Development Corp. of the Philippines balked in late 1976 at supplying China with the 5,000 tons remaining on a 20,000-ton import order for copper cencentrates because of the considerable rise in copper prices since the initial agreement. Subsequently, however, the Philippines was said to have sold China 40,000 tons of copper concentrates valued at $12 million, which pushed total Philippine copper sales to China to $36 million.[7]

Iron and Steel.—It was an unimpressive year for the iron and steel industry. Performance was uneven, and basic construction lagged. Overall steel output declined to possibly the 26-million- to 28-million-ton range; some estimates were much lower. Production was adversely affected either directly or indirectly by the Tangshan earthquakes and by political unrest, particularly at Wuhan. Kailan's coking coal was in short supply because of the earthquake disruptions. Nevertheless, most major plants held their own in 1976, with basic oxygen furnaces making a significant contribution. The Wuhan plant may have been somewhat behind schedule in installing its foreign equipment. The country was saving

[7] China Trade Report. V. 15, May 1977, pp. 3–4.

tin for a new tinplate mill to be completed at Wuhan. Medium and small steel plants, which produced one-fourth to one-third of the country's steel, encountered setbacks in northern China because of the earthquakes but did well in southern China. There were signs at yearend that Chinese steel output would more than recover in 1977.

Problems in steel production and metal shortages in general caused difficulties for all heavy industry. Inadequate supplies meant lower inputs for vehicles, mechanical equipment, farm machinery, and other important products. Shortages of steel were becoming increasingly acute, because of the agricultural mechanization program and the sharply expanding use of petroleum which had to be distributed to the markets. Southern China may have been slightly better off, since many small plants and industries recently established south of the Yangtze River drew on local supplies of raw materials.

China has been importing 4 million to 5 million tons of iron and steel products annually to complement domestic output. The country was extremely short of finished steel, particularly seamless steel pipes. Japan has been China's leading steel supplier by far, sending nearly 3 million tons of products to China in 1974 and 1975 and 4 million tons in 1976. The newly contracted tonnages from Japan were 650,000 tons in the first half and 1,590,000 tons in the second half of 1976. The Chinese were not as willing to buy steel as the Japanese were to sell, partly because of the difficulty of paying for it by selling oil. However, this situation was expected to be temporary, since Japan is the most logical supplier of steel to China and buyer of petroleum from China. At yearend, talks were being arranged to stabilize steel imports from Japan, increase oil exports, and develop new coal production for the Japanese market.

In a special magazine section of the Takungpao dated November 1976, an article entitled "New Developments in Iron and Steel Smelting Technology" showed a pictorial model of a steel plant with three-unit 120-ton basic oxygen furnaces capable of turning out 2.5 million tons of steel annually. This clearly illustrated what the Chinese steel planners were thinking about. The Chinese-designed 120-ton-per-heat furnace was being promoted, and sizable basic oxygen furnaces reportedly have already been installed at the Anshan, Penhsi (Pench'i), Shanghai, and Paotou steelworks. The whole smelting process was described in the article, pointing out the great advantages of basic oxygen furnaces over open-hearth operations: Lower unit investments, shorter construction time, higher production, and better quality control. It was further stated that Chinese technologists were working on recovery of fuels from smoke and dust, reuse of iron oxide dust as iron raw material, use of slag for cement manufacture, and better utilization of waste heat. China may already have a 150-ton basic oxygen furnace and was studying even larger furnaces.

The Anshan plant continued to overshadow all other Chinese steel plants, and it was used as a model at yearend to exhort other steelworks to better performance in the year ahead. Anshan had 11 blast furnaces (the last was a 2,000-cubic-meter one), 25 open-hearth furnaces (200- to 500-ton capacity), 2 large basic oxygen furnaces, various mines and sintering and beneficiation plants, and blooming, plate, hot strip, rail, and pipe mills. Anshan's steel ingot capacity may have been just over 7 million tons, and output in 1976 probably was about this level; record production was claimed for the first half of 1976. Anshan's mines produced concentrates of more than 60% iron grade, and the recently installed sintering plant is sizable. One production unit with a 4-cubic-meter shovel (at the Kungch'angling mine) produced at a level of 10,000 tons per day of run-of-mine ore during late 1976. Anshan iron ore is much like Mesabi ore in the United States, but Anshan did not have pelletizing plants. In 1976, the Japanese sold a Kowa Seiko sulfide iron ore pelletizing plant to China; however, this probably was not for Anshan since the ore there is known for silicates rather than sulfides.

Wuhan's three byproduct coke plants, large sintering plant, four 1,400- to 2,000-cubic-meter blast furnaces, eight mostly 500-ton open-hearth furnaces, hot-rolling mill, plate mill, and rail mill have been producing steel ingot at an annual rate of more than 2.5 million tons. Wuhan had at least four iron mines, including the Tayeh open pit and the Ch'engchao and Tahung-

shan underground mines. Meanwhile, $550 million worth of West German and Japanese fabrication equipment was being installed: A new 3-million-ton hot strip mill (including a 70,000-ton silicon Sendzimir steel mill and a tinplate line), a 1-million-ton cold strip mill, and a continuous-casting mill. Some said that installation of these foreign mills would be delayed as much as 18 months after late 1977 (the original date), yet it had been reported that the Chinese have been saving tin for the tinplate line. Since the new fabrication equipment seemed to be superimposed on already adequate facilities, it would not be surprising if Wuhan may in the near future be building additional blast furnaces or large basic oxygen furnaces. Wuhan's October 1976 steel output was said to be 39.4% higher than the September 1976 output,[8] possibly indicating its problems during the early part of 1976.

The Peking steelworks, also known as the "capital" or Shihchingshan steelworks, had stabilized at about 1.5 million tons of steel ingot and 2 million tons of pig iron annually and was a showcase for foreign visitors. Actual production in 1975 and 1976 was said to be somewhat lower. The Peking steelworks had two 400- to 500-cubic-meter and two 1,000- to 1,200-cubic-meter plant furnaces. It also had three 30-ton basic oxygen furnaces, several fair-sized open-hearth furnaces, a coke plant, a sintering plant, a blooming mill, a billet mill, and a bar mill. The Chiennan and Lungyen mines supplied the Peking steelworks with over 60% grade concentrates. This steelworks was very diversified, having about 100 operational units, including facilities for making ferroalloys, refractories, cast iron pipes, and nonferrous metals. The earthquake may have affected this steelworks somewhat.

The Taiyüan steelworks in Shansi Province was made famous by the installation of a pair of 55-ton Austrian basic oxygen furnaces in the early 1970's. There were probably three plants, one to house the basic oxygen furnaces, a second for open-hearth furnaces, and a third for electric furnaces. The Taiyüan steelworks had five blast furnaces, including one of 963 cubic meters and another of 291 cubic meters; at least one blast furnace had been greatly enlarged. With the recent completion of a large open pit mine called Okou, the Taiyüan steelworks became totally integrated and self-sufficient in iron ore. A large sintering plant was built in 1970. There were a blooming mill, a cold-rolling mill, and a sheet mill. Steel capacity was more than 1 million tons. This steelworks had been exceeding targets in the previous 5 years. The Taiyüan steelworks was reported to have a good research institute.

Shanghai had perhaps eight steel plants; only one-half of these were ingot producers. The No. 1 steelworks appeared to be the largest, followed by the No. 3 steelworks. Shanghai as a whole had a steel capacity of at least 3 million tons and possibly as much as 5 million tons. The No. 1 steelworks had three 30- to 35-ton and one 120-ton basic oxygen furnaces and two 70-ton open-hearth furnaces. The medium-size Maanshan steelworks in nearby Anhwei Province reportedly raised output steadily during 1976. The medium-size Tangshan steelworks suffered serious damage during the earthquakes but apparently resumed production fairly quickly. The Paotou steelworks started to produce sizable tonnages of pipe for use in oil distribution. A new 150,000-ton-per-year steelmaking unit of the medium-size Lanchow steelworks was brought into production in fall of 1976.

Tin.—The Chinese tin industry probably did not undergo much change during 1971–76, but assessments of its performance have varied. Overall tin reserves (1.5 million to 2 million tons) were still acknowledged as large. Kuch'iu, with its widespread ore bodies occupying 500 square kilometers in Yunnan Province, and "Fuhochung," embracing Fuch'uan, Hohsien, and Chungshan in Kwangsi Chuang Autonomous Region, were still considered China's principal tin-producing areas. A new placer district called Chiumou was mentioned for Kwangsi Chuang Autonomous Region, and byproduct tin of Kiangsi Province has long been of some significance. A recent book[9] lists all of the Chinese tin deposits known to the author during the early 1960's. Although some feel that national production may have dipped below the 20,000-ton-per-year

[8] Jen-Min Jih-Pao (Peking). Nov. 4, 1976, p. 1.

[9] Ikonikov, A. V. Mineral Resources of China. Geological Society of America, Boulder, Colo., 1975, 500 pp.

level, the view cannot be substantiated. In fact, Japanese experts believe that Chinese tin production could be substantially greater.

The Kuch'iu nonferrous complex in Yunnan has been the mainstay of the Chinese tin industry for decades. New reserves of mainly lode tin have been steadily found to compensate for what is mined out. Tin ore at 2% to 4% is high grade, but base metal impurities present beneficiation and metallurgical problems. Much construction and expansion took place in Kuch'iu in the late 1950's, and another push occurred around 1970 when the Kohsien mine was basically mechanized and expanded several-fold. Previously, some of Kuch'iu's refined tin was not very high grade; however, the quality of this tin has been greatly improved through the apparent addition of electrolytic refining facilities in recent years. There was an earthquake in Yunnan Province in spring of 1976. China's second-ranked tin center, Fuhochung, has clean placer tin. The tin there is of 99.9% quality or better, the potential seemed good, and deposits were easily workable by methods employed by Chinese tin miners in Southeast Asia.

Chinese tin, long an important export product and significant in the international tin market, once again entered world trade in sizable tonnages. Accountable imports of Chinese tin by consuming countries indicated that totals approximated 10,000 tons in 1974, then increased substantially in 1975 before dropping to 7,000 to 8,000 tons in 1976. With no tin duty, U.S. imports of Chinese tin rose to 3,336 tons in 1974 and about 6,350 tons in 1975 before settling back at 1,700 tons. The tin industry was at first alarmed by the sharp increases in Chinese tin exports but later realized that China had no intention of sustaining these levels despite having refrained from joining the International Tin Council. Both the Bolivians and the Malaysians had visited China, although they were unable to shed much light on tin developments. Chinese tin consumption may have risen to 8,000 to 9,000 tons annually, and a new 100,000-ton-per-year tinplate line being completed at the Wuhan steelworks should boost tin use further. Thus, unless production is stepped up, China may have less tin to sell even though prices have skyrocketed to nearly $5 per pound. China undoubtedly stockpiled considerable tin (very likely at least 50,000 tons).

Tungsten.—China's extensive tungsten resources were being mined at an estimated annual rate of 15,000 to 20,000 tons of concentrates. Domestic consumption has steadily risen because of the expanded use of drillbits and machine tools, and annual requirements apparently already surpassed 7,000 tons per year. There may be need for stockpiles to be built up also. Exports of concentrates declined to possibly the 8,000- to 9,000-ton level in 1976 despite very high tungsten prices. It seems that the Chinese must invest and explore more in order to avert a decline in tungsten output. An entire line of tungsten products was produced by the Chinese, including synthetic scheelite, paratungstate, powder, wire, and tungsten carbide. Although regularly attending the Geneva meetings of the United Nations Conference on Trade and Development (UNCTAD) and the Primary Tungsten Association, China continued to keep silent on its tungsten situation. However, the Chinese did imply that exports in 1977 may be down as much as 50% and that they would go along with price-stabilizing efforts of other major tungsten producers.

Most Chinese ore is high-grade wolframite from Kiangsi Province, but scheelite from Hunan Province and wolframite from Kwangtung Province has also become important. There were probably a dozen mines in 1976 capable of producing 500 to 2,000 tons per year of concentrates, as well as many other smaller mines in the "tungsten belt" along the Nan Ling Range. The best-known mines in Kiangsi were Hsihuashan, Tachishan, Kueimeishan, and P'ankushan. Chinese tungsten ores could contain important amounts of tin and some molybdenum and bismuth as well. In fact, Kiangsi tungsten mines were the primary source of China's bismuth. Considerable geophysical exploration has been done in recent years on the known deposits of Kiangsi, and the many "hidden" ore bodies discovered helped to rejuvenate the tungsten industry.

A typical large Kiangsi mine in the Tayu area has hundreds of veinlets in a mineralized zone of several square kilometers. Possibly two sets of very steep veinlets averaging 0.3 meter in thickness (the thickest part may be 3 meters) extend 0.25 to 1 kilometer in length and 100 to 250 meters in depth. Ore grade is uneven but

may average 1.2% WO_3 and over 0.5% tin. A single large mine can have over 100,000 tons of contained WO_3 as reserves. Mining was well engineered and at least semimechanized, with daily ore production often 2,000 tons and more. There was in most cases a fairly good mill capable of at least 90% recovery of valuable constituents.

Hsihuashan has been modernized into a fairly efficient mine, and its mill apparently has been streamlined. The P'ankushan mine had a good record of meeting production targets. A large but deep ore zone was discovered at Tachishan a few years ago which brought new life back to this old mine. Hunan mines are best known for scheelite, and one of these may be Yangchiat'an. Two better known wolframite mines in Kwangtung Province are Yang-chiang and Yaoling. Most Chinese tungsten ores entering the world market were medium-high grade. The small tonnages of scheelite recently sold contained moderate amounts of impurities, and one wonders when synthetic scheelite plants will be built for marketing advantages.

Other.—Chinese deposits of rare-earth elements are large by world standards and widely distributed. In less than 20 years, China emerged as a very important producer, consumer, and exporter of materials such as lutetium, praseodymium, neodymium, dysprosium, erbium, ytterbium, gadolinium, holmium, and yttrium. Reports from the recent Canton Fairs said that China had been offering not only the rare-earth elements but also ferroalloy metals, such as beryllium, beryllium-copper alloys, tungsten powder, ferro-tungsten, electrolytic manganese, molybdenum, barium, columbium, columbium oxide, ferrophosphorus, zirconium, and titanium. China also sold concentrates such as xenotime, columbite, zircon, lithium mica, spodumene, single silicon crystal, and natural and synthetic quartz crystals, and many kinds of high-purity metals (99.99% to 99.9999%) such as tellurium, arsenic, cadmium, gallium, copper, lead, zinc, tin, bismuth, antimony, nickel, phosphorus, sulfur, boron, and lithium. The National Rare Earth Conference convened in Paotou, and the Rare Earths Institute was established at Lanchow during 1975. These developments indicated that China has achieved considerable sophistication in providing quality materials needed by modern industry.

Kwangtung Province's "rare metals" industry was recently described as having been developed after the Cultural Revolution.[10] Beneficiation and extraction technology related to some 40 types of rare metals reportedly has been mastered. During the fourth 5-year plan (1971–75), output value increased threefold each year to meet the needs of the metallurgical, nuclear, chemical, electric, electronic, semiconductor, and "special area" industries. Apparently, rare metal raw materials have been found in many parts of the Province, both in hilly inland and flat seashore regions. Developments at the Pant'an tin mine are significant; discovered in 1958 for tin, this mine reportedly recovered about 11 types of byproducts which together constitute two-thirds of the mine's output value. Germanium used for defense purposes is a new byproduct recovered, and technology has progressed to a point that germanium recovery reached 75%. Kwangtung Province was more than self-sufficient in rare metals.

NONMETALS

Asbestos.—Chinese production of asbestos remained at the approximate level of 150,000 tons per year. Shihmien, Szechwan, with about a dozen fairly up-to-date projects producing long-fiber chrysotile asbestos, continued to be the country's leading producer by far. A second major asbestos deposit was located at P'enghsien, Szechwan, near Shihmien. Laiyüan County of Hopeh Province may be the most productive of the lesser sources, and its product is fairly good-grade chrysotile asbestos. Chinhsien in Liaoning Province reported a 23% rise in output during the first half of 1976 over the same period 1 year ago. There is no news concerning the newly found deposit in Yüankiang County, Yunnan Province.

Barite.—Chinese output of barite probably approached 300,000 tons in 1976, 5.5% of the world total. The steady gain in production was a reflection of the growing domestic market in oil and gas drilling. China seemed to have extensive and widespread deposits of barite and a good surplus of 90% to 97% grade barite available for export. China's exports have greatly declined since 1974.

[10] Takungpao (Peking). Aug. 17, 1976, p. 3.

Cement.—The cement industry continued to expand, with estimated production exceeding the 35-million-ton level in 1976. The French were helping to build a large cement plant at an unknown location. China had at least 30 large cement plants each capable of producing more than 200,000 tons per year, with 4 rated at more than 1 million tons. One of these large plants, a 700,000-ton facility at Tangshan, was said to have been a casualty of the severe earthquake in late July. There were more than 30 other plants with capacities in excess of 100,000 tons annually. China had more than 3,000 small cement plants; one common size range was 3,000 to 7,000 tons, and a second was 10,000 to 50,000 tons. These plants accounted for more than one-half of the national output of cement. The Chinese claimed that the small plant sector fulfilled the 1976 target 33 days ahead of schedule and produced about 7% more cement than in 1975. Apparently, Shantung led the provinces in small cement plant production, with output in 1975 reported at 2.44 million tons[11] and output in 1976 at least 20% higher. Kwangtung Province with 190 small cement plants produced 12% more in 1976 than in 1975, and these small plants accounted for 70% of the Province's cement output.

Diamond.—China's need for industrial diamond has steadily increased, particularly for drilling purposes. Until 1971, most of the diamond was imported. It was around that time that the Changte diamond mine in western Hunan was brought into production. In late 1973, synthetic diamond manufacture began, and by 1976 there may have been a dozen synthetic diamond plants operating in China, producing small industrial diamonds. It was said that synthetic diamond drillbits were used to drill China's deepest oil and gas drillhole (6,011 meters in depth) somewhere in Szechwan Province. In mid-1976, an important diamond deposit was found in Liaoning Province.[12] The drilling and exploration program of China suffered from inadequate supplies of large enough diamonds.

Fertilizer Materials.—*Nitrogen.*—China had an estimated production of between 3 million and 4 million tons of contained nitrogen in 1976, significant by world standards. Considering the growth of the oil and gas industry, the program to build many more small nitrogenous fertilizer plants, and the 13 new large foreign plants (including 8 Kellogg plants in the Provinces of Heilungkiang, Liaoning, Hopeh, Yunnan, Kweichow, Hupeh, Hunan, and Szechwan) in various stages of construction, the country's fertilizer production should reach 7 million to 8 million tons of nitrogen by 1980. The Kellogg plants in Liaoning, Hopeh, Heilungkiang, and Szechwan were to be completed by the end of 1977.

China was still greatly dependent upon imports of nitrogenous fertilizers, mainly from Japan. Sino-Japanese trade in fertilizers was very important in world transactions. In 1975, Japan exported 1,169,000 tons of urea (46% nitrogen), 307,000 tons of ammonium sulfate (21% nitrogen), and 499,000 tons of ammonium chloride (over 25% nitrogen) to China, down considerably from that of the peak year of 1973. The agreement for the first half of 1977 was for Japan to ship 500,000 tons of urea and 200,000 tons of ammonium sulfate to China. The Chinese negotiated additional contracts to purchase over 300,000 tons of urea from Eastern European countries in 1976, plus significant amounts of ammonium sulfate from Western European countries.

In addition to about a dozen large nitrogenous fertilizer plants that have been in operation for some time and a similar number of large plants being built, China had more than 1,200 small- and medium-size nitrogenous fertilizer plants scattered around the country. In 1975, small plants provided 58% of China's total synthetic ammonia output. Production from small plants underwent a further sharp increase in 1976. A typical small plant produces 3,000 to 5,000 tons per year of aqueous ammonia or ammonium bicarbonate. Medium-size plants may produce 50,000 to 100,000 tons per year.

Shantung has become the leading nitrogenous fertilizer producing province in China. In 1976, there were about 120 small plants and one large plant. In early 1977, the Shengli general petrochemical complex associated with the oilfield of the same name was placed in full-scale operation; it had two chemical fertilizer plants in addition to oil refineries and plants producing

[11] New China News Agency (Peking). Nov. 16, 1976, p. 4.
[12] Takungpao (Peking). July 25, 1976, p. 1.

synthetic rubber and petrochemicals. The Taching oilfield also had a recently completed large chemical fertilizer plant based upon natural gas, capable of producing 1 million tons of various fertilizers annually.[13] Szechwan Province had nearly 100 small nitrogenous fertilizer plants plus a number of large plants (including a plant rated at 1 million tons of fertilizers), all based upon natural gas. Kwangtung Province also had a growing number of fertilizer plants, particularly small ones.

Phosphate.—China's phosphate rock production capacity may have risen to about 4 million tons per year in 1976. A few years earlier, imports were as high as 2 million tons, mainly from Morocco and the Lao Cai apatite deposit in northern Vietnam. When Morocco tripled its price, Chinese imports dwindled to small tonnages. Morocco subsequently cut its prices, perhaps making it again attractive as a source of high-grade ore.

The bulk of the phosphate rock was converted to chemical phosphates, although some was directly applied in ground form. China must have had about 1,500 small phosphate plants (430 in Shantung Province), which together produced three-fourths of the country's chemical phosphate, totaling possibly 10 million tons per year. Relatively large superphosphate plants that have been mentioned in the press include Nanking, Ch'angsha in Hunan, Hunghochou in Yunnan, Shanghai, Taiyüan in Shansi, Canton and Chanchiang in Kwangtung, and Tunghsiang in Kiangsi.

China's phosphate rock resources are widespread throughout the eastern and southern areas of the country. Most deposits are sedimentary rather than igneous in origin. Reserves are large, but the quality is uneven and often poor. The best known deposits are located in the Provinces of Yunnan, Kweichow, Hunan, and Hupeh. In Yunnan, there were open pit and underground mines in the K'unming and K'unyang areas and probably apatite deposits near the Vietnamese border. The Kaiyang region of Kweichow, with more than one large mine, has been worked for a decade. Liuyang, Shihmen, and Huach'iao are known locations of phosphate mining in Hunan, where output has risen tenfold since 1965. The Chinghsiang mine in Hupeh had an annual capacity of 600,000 tons per year of phosphate rock. A 20-million-ton phosphate deposit reportedly was discovered in the Ch'aoyangli area of Kiangsi Province.

Phosphates are found in many localities in Foshan, Kwangtung Province. A large deposit of high-grade ore was recently reported in the Hsuai-yi-ling area on the shores of the Tatu River in Szechwan Province. A large phosphate rock deposit was found at Fanshan, Chülu County, Hopeh Province.[14] This deposit was said to be the largest of its kind found in northern China, and its development would mean that phosphate rock from the distant Hunan and Kweichow Provinces would no longer have to be shipped in. Shantung Province had many small phosphate operations also.

Fluorspar.—China has long been a prominent world producer and exporter of fluorspar, and output in 1976 probably exceeded 350,000 tons. A large surplus has been traditionally exported, mainly to Japan which took 179,485 tons in 1974 and 107,611 tons in 1975. The U.S.S.R. took 84,840 tons in 1974 and 55,407 tons in 1975. However, Japan's overall steelmaking and aluminum requirements for fluorspar have been declining. On the other hand, China's domestic consumption was approaching the 100,000-ton-per-year level for fluorspar. The United States reported receipt of a trial shipment of about 6,300 tons of Chinese "high-grade lump" fluorspar in July 1976. Most Chinese fluorspar is metallurgical grade, but a significant share of output was acid grade. The leading producing districts had been Wuyi in Chekiang, Kaip'ing in Liaoning, and Lunghua in the Jehol region. The Taolin mine in Hunan produced over 80,000 tons of acid-grade fluorspar in 1976, along with lead and zinc. Taolin's 3,000 tons per day of ore milled analyzes 10% to 15% fluorspar and 3% combined lead-zinc. A similar but smaller mine operated at Hengtung, also in Hunan. It had about 1,000 workers and two mills totaling less than 500 tons per day of ore. Hengtung's fluorspar output was about 20,000 tons per year, and combined lead-zinc output was 3,000 tons per year.

[13] Takungpao (Peking). Dec. 20, 1976, p. 2.
[14] New China News Agency (Peking). Jan. 21, 1977, p. 4.

Salt.—There were no claims for salt production in 1976, probably because of the earthquakes and other difficulties during the year. Several large saltfields are around the Gulf of Pohai, near the earthquake areas. However, there was no particular reason why these saltfields should have been greatly affected. Apparently, the southern saltfields did well; Kwangtung Province's output was said to have increased 40% and Hainan's output 25% over that of 1975. Record high production was also reported for Szechwan Province and Sinkiang Uighur and Ningsia Hui Autonomous Regions. It was estimated that Chinese salt production in 1976 was at least 30 million tons.

Soda and Borates.—A comprehensive survey carried out by Chinese scientific workers on the Tsinghai-Tibet Plateau established the fact that Tibet has about 1,000 lakes covering nearly 30,000 square kilometers or one-third of the country's total lake area. Most lakes are brackish, many are deep, and a good number are dry. The lakes reportedly contain rich mineral and aquatic resources. Abundant deposits of salt, soda, sodium sulfate, and borax are found in many of the lakes in northern Tibet.[15] The survey team under the Chinese Academy of Sciences further verified that one small salt lake contains 5 million tons of salt and 50 million tons of sodium sulfate.

Talc.—China's leading talc-producing area was centered around Tashihch'iao and Taling in Liaoning Province where the mineral is associated with magnesite and soapstone. Chinese magnesite is very extensive in this area and is already exploited in large tonnages. The talc is best known for its high quality in world markets. Local demand for this important filler and auxiliary material was steadily increasing, but large tonnages were still available for export. In fact, the Chinese advertise "talc lumps" from many areas, including Haich'eng, Hsiuyen, and Yingk'ou; Liaoning, Shantung, and Kwangtung Provinces; and Kwangsi Chuang Autonomous Region, and "talc powder" of 200 or 325 mesh. Japan, the main customer, imported 134,624 tons of Chinese talc in 1974, 97,052 tons in 1975, and 151,276 tons in 1976, in addition to soapstone and magnesia clinker.

MINERAL FUELS

Coal.—Coal output showed possibly only a 2% to 3% gain over the 1975 production and was no doubt held back by the major earthquakes in northern China. Kailan's demise was more than made up for by increased output in most other centers and at the small coal mines south of the Yangtze River, where production reportedly gained 10.7%. China's coal output in 1976 was in the 450-million- to 490-million-ton range, corresponding to at least 400 million tons of good U.S. coal. Many coal mine conferences were organized during the year. The most important one was the National Conference held in mid-November in Peking calling upon the 3 million coal workers to "work particularly hard during the last 40 days in order to fulfill the (1976) target."[16] At that conference, red flags were awarded to the 10 best coal-mining teams. A 1,500-meter coal drill was successfully manufactured. A coal cutter capable of adjusting to different thicknesses of coal seams was built in Kirin Province.

It has become abundantly clear that the nine provinces in the Chiangnan region south of the Yangtze River possess considerable coal. During the last decade, Chiangnan's proven reserves and actual production have more than tripled, and its self-sufficiency rate reportedly has increased from 50% to 70%.[17] Two-thirds of the counties and cities in Chiangnan possess coal resources. "Several tens" of deposits have proven reserves exceeding 100 million tons each, such as the anthracite of Hsiangshui, Hunan; Huangshih, Hupeh; Hoshan, Kwangsi Chuang; and Shaowu, Fukien; the "fat coal" of Wusi, Kiangsu; the gas coal of Changkuang, Chekiang; the coking coal of Fengch'eng, Kiangsi, and Huaipei, Anhwei; the brown coal of Hainan Island, Kwangtung; etc. Even in coal-poor Chekiang Province, minable coal reserves have been found in about 27 counties. Kwangtung Province's coal output rose from just over 100,000 tons per year to approximately 4 million tons.

Kailan provided the big news for 1976, with the earthquakes striking Tangshan

[15] New China News Agency (Peking). Apr. 28, 1977, p. 5.
[16] Takungpao (Peking). Nov. 20, 1976, p. 1.
[17] Takungpao (Peking). Dec. 11, 1976, p. 1.

and Fengnan in late July. Tangshan, one of seven coal mines of Kailan combine (or bureau), was literally mangled, with its shafts twisted and many workers caught underground. The cement plant was put out of commission, but the steelworks was brought back into production fairly quickly. Although Tangshan had the most damage, the other six mines were hit also. Overall earthquake casualties apparently were between 1 million and 1.5 million people, of which roughly one-half died. All of the large coal combines sent rescue teams to help, along with supplies and equipment. Some Kailan mines resumed production quickly, and in a little over 2 months, six of the seven mines were producing coal again. The Lüchiat'un mine had returned to nearly 8,000 tons of output per day by mid-December. The Chaokochuang mine hoped to raise production to 2.3 million tons in 1977, its pre-earthquake rate. Kailan as a whole produced over 20 million tons of marketable coal (not raw coal) in 1975, and the estimate for 1976 was approximately 15 million tons.

Yearend news on the performance of Chinese coal combines and individual provinces was not as abundant as it was a year earlier. This may reflect lesser gains in output. However, the catastrophe of the Tangshan earthquakes and the abundance of other significant events probably also had a bearing on the reduced news coverage. Many large coal mines around the country dispatched their best people along with valuable equipment to Kailan, which no doubt hurt their own output somewhat. Another National Coal Conference was convened in January 1977 to stimulate coal production. No effort is made here to give detailed data on individual mines and facilities, which can be found in a book by this author.[18]

Shansi coal mines did well in 1976. This Province, virtually underlain by coal, produced about one-sixth of China's total and has plans to expand output severalfold. The Tatung bituminous coal combine, with 13 pairs of major mine shafts, reportedly produced 20 million tons of coal (corresponding to at least 15 million tons of marketable coal) in 1976, which was about twice that produced by the Yangchüan anthracite combine, with 12 pairs of mine shafts. Tatung was said to have achieved its target 37 days ahead of schedule and surpassed the 1975 output rate by about 13%; Yangchüan's record was 43 days and 11%, respectively. Tatung apparently has been increasing output by 2 million tons annually in recent years.

Fushun and Fuhsin, the two best known coal combines in Liaoning Province, had the largest open pit operations in all of China, which is better known for its underground coal mines. Fushun, with two pits and three deep mines, apparently met output targets in 1975 and 1976, although actual production may have declined to possibly 12 million tons of clean coal. This combine had electric shovels and heavy media plants. Fushun, starting with coal and oil shale and branching into oil refining, chemicals, and nonferrous metals, has become one of China's major industrial bases. Fuhsin was on the upswing in coal production because of the discovery of extensive new reserves during the early 1970's. Production quotas were generally met, and 1976 output of clean coal by this combine probably was about 17 million to 19 million tons. Fuhsin has the Haichow and Hsinch'iu open pits and an underground operation at P'ingan.

Shuangyashan was the smallest of three important bituminous coal combines in Heilungkiang Province, the others being Hokang and Chihsi, which each produce 10 million to 12 million tons annually. Shuangyashan reportedly attained its 1976 target on November 12 and established a record high annual production in the process. Chihsi fulfilled the year's target on November 25, and Hokang recently installed a pair of new shafts at the Suli mine rated at 1.4 million tons per year. Shantung was singled out as a province that performed well, fulfilling the 1976 target 38 days ahead of schedule with output increasing 4.5 million tons over that of 1975. With coal production in the 30-million- to 35-million-ton-per-year range, Shantung was also well known for oil and fertilizers.

The two large coal combines in Anhwei Province were mentioned in the news. Huainan (the older and larger one) and Huaipei together produced up to 20 mil-

[18] Wang, K. P. Mineral Resources and Basic Indusries in the People's Republic of China. West View Press, Boulder, Colo., May 1977, 225 pp.

lion tons of marketable coal in 1976. Huainan's old Tatung mine has been rejuvenated, achieving its target more than 3 months ahead of schedule. With 10 modern shaft mines and a large coal beneficiation plant, Huaipei established a record high output in meeting its 1976 goal by late November. A new large coalfield called Linhsi reportedly was discovered in Anhwei Province.[19] Located in the Shuhsien region, Linhsi coal reserves are said to be more than three times those of the Huaipei combine according to preliminary estimates, coal quality is excellent, and coal types cover a wide range.

P'ingtingshan, a relatively new coking coal base in Honan Province with 13 collieries and 70,000 workers, had already achieved a production level of 10 million tons per year of run-of-mine coal by 1975. However, 1976 seems to have been a difficult year, with political difficulties apparently slowing down operations. Output in early September dropped to below 15,000 tons per day, although operations returned to normal by yearend. Two new coal centers in outlying areas were brought to light in May. Holanshan in Ningsia Hui Autonomous Region, located at the "gateway to the northwest," was probably producing more than 5 million tons of clean hard coal annually from mostly underground mines. Paoting, located in the mountains of southern Szechwan Province, has also been built up to a 5-million-ton-per-year coal base; its coal is medium-volatile coking coal.

Petroleum and Natural Gas.—Oil production was estimated at about 90 million tons (or 1.8 million barrels per day) in 1976, although some feel the figure may have been as low as 85 million tons. It was officially announced that the gain over 1975 was 13%.[20] By mid-1976, the national output rate had reached 100 million tons per year. However, growth was subsequently slowed down by adverse factors such as the Tangshan earthquakes (which definitely affected the Takang oilfield), export and distribution difficulties, construction of port and refinery facilities, and major political happenings. Taching, the main field, exhibited a growth rate much lower than the national average, exemplifying the behavior of a mature field. On the positive side, startup of a third large oilfield near the Gulf of Pohai, comparable in magnitude to the Takang oilfield, was announced near yearend, with the location given as between Yingk'ou and Chinchou in Liaoning Province.[21]

China ranked 10th among world oil producers in 1976; however, output corresponded to only about 15% to 25% of the tonnage produced by the world's four leading producers. There is no evidence that China can ever become one of the top four oil producers, but doubling of output within a decade to 200 million tons was well within reach. The new Yingk'ou-Chinchou oilfield added to the potential, and other onshore fields were being developed. New reservoirs and production zones were reported for most of China's leading oilfields. The Chinese felt very hopeful about offshore possibilities, particularly on the northern and southern coasts. In recent years, they dispatched equipment and exploration teams to countries such as Norway, West Germany, Venezuela, Singapore, and the United Kingdom where offshore oil and gas production was due to rise sharply. The Chinese apparently were wavering between a policy of rapid and intense development of oil and gas, so as to expand exports for earning more foreign exchange, and a conservative policy of a balanced program of oil, gas, coal, and electric power. In any case, the Chinese showed no indication of accepting production-sharing contracts, not to speak of joint ventures, although they clearly knew the importance of foreign technology and equipment.

China did not export as much oil in 1976 as might have been expected—perhaps 10 million tons, slightly lower than in 1975. Exports to Japan declined from 8.1 million tons in 1975 to 6.8 million tons in 1976, mainly because of Japanese reluctance to take more of China's waxy crude and concern over Chinese political sensitivity toward exports. Shipments to North Korea may have increased because of the new pipeline installed, whereas shipments to Romania may have been about the same and shipments to Southeast Asia a little lower. Most people assessing Chinese oil exports felt that the tonnage by the early

[19] Takungpao (Peking). Mar. 28, 1977, p. 1.
[20] New China News Agency (Peking). Jan. 5, 1977, p. 1.
[21] Takungpao (Peking). Dec. 21, 1976, p. 3.

1980's may be close to 20 million tons but is not likely to be much higher. The program of installing pipelines and building oil-handling ports and coastal tankers made significant headway in 1976, as did efforts to construct additional refineries and petrochemical facilities. With larger production and little change in exports, it follows that consumption was increasing, and this means more industrial facilities, diesel plants and trains, oil-fired cement plants, vehicles, petrochemicals, fertilizers, and farm mechanization. Without many private cars, 70 million to 80 million tons of petroleum annually means a great deal to the economy of China.

The Taching oilfields near Harbin probably produced about 35 million tons of oil in 1976. The official report was that output in 1976 was 8.7% over the 1975 output, which in turn was 13.4% more than the 1974 output. In evaluating its potential and production, two very important points stand out. One is that Taching had a new field called Ta-king, some distance from the existing center, that was opened in late 1973. The second is that the drilling and water-injection system of the old field was recently changed from "line drive" to "9-spot," which meant better recovery but lower output. Western newspapers had been reporting that production of Taching may have peaked. This was probably true in the sense that annual output may not greatly exceed 40 million tons in the future, although it should be remembered that the Sungliao Plain where Taching is located is a sizable area. However, production at Taching very likely will last for decades, although it shows signs of maturing. Interest in Taching's oil was universal, and, of late, some was shipped by pipeline to North Korea. The refinery at Taching produces only 5 million to 6 million tons annually. A recently completed large fertilizer plant was rated at about 1 million tons of fertilizers and 300,000 tons of synthetic ammonia yearly.[22]

The Shengli oilfield near the mouth of the Yellow River, with oil reserves on a par with Taching, produced more than 15 million tons (perhaps 17 million to 18 million tons) of crude oil in 1976. Output in 1975 was said to be 33% more than in 1974. However, the official statement for 1976 only mentions that State quotas for crude oil and all other major products were overfulfilled, and "new discoveries have been made in prospecting."[23] Two fertilizer plants, a catalyst plant, and a synthetic rubber plant were in operation, and there was a plan to change the course of the Yellow River. Shengli had a 2.5-million-ton refinery and a 3.5-million-ton refinery, which were connected by pipelines across the Shantung Peninsula to the new Huangtao port near Tsingtao.

The Takang oilfield, near the Gulf of Pohai 60 kilometers southeast of Tientsin, had not yet been totally built up, although annual output may have already reached 12 million tons. Takang's crude oil output gained 60% in 1973, nearly 25% in 1974, and 16% in 1975. Its actual 1976 production was reported as close to the State quota. The Tangshan earthquakes hit Takang mildly. Chinese reports said that extraction never stopped; although production declined in the first 2 days, operations returned to normal on the 3d day. Only a relatively small refinery was in existence in early 1975, but a large petrochemical complex of the scale of the one at Chinshan near Shanghai was under construction in 1976. The hope was to also produce liquefied natural gas for export to Japan. Oil and gas were piped to Tientsin where a large refinery and petrochemical complex were being expanded. Additionally, a pipeline had been built from Tientsin to Hsinkang, probably with a view toward exports.

A new oil and gas field was found in mid-1976. The Yingk'ou-Chinchou field is slightly inland from the Gulf of Pohai, covering 62 kilometers in length and possibly extending into the Gulf. Development began in 1974, and the first well, which was reportedly heavy in sulfur smell, was spudded on June 25, 1976. Yingk'ou-Chinchou has been proclaimed as northern China's fourth big oilfield, the others being Taching, Shengli, and Takang. As far back as 10 to 12 years ago, it was felt that promising oil resources might be found in this area.

The Karamai oilfields located in the western Dzungarian Basin in Sinkiang Uighur Autonomous Region, 147 kilometers by

[22] Takungpao (Peking). Dec. 28, 1976, p. 1.
[23] New China News Agency (Peking). Jan. 2, 1977, p. 1.

pipeline to the Tushantzu refinery, had expanded production twofold in a decade. In 1975 alone, output was raised 65% over that of 1974. All major production goals for 1976 were said to have been met, and these were higher than the 1975 levels. Karamai's oilfields have been streamlined and a new field built, equipped with measuring and transfer stations, necessary derricks, and 50 kilometers of new pipelines. Annual crude oil output may have risen to the 6-million- to 7-million-ton range.

China's natural gas has become a very significant resource on a par with oil, and production should rise sharply in the years ahead. Marketed output of natural gas reportedly increased 14% over that of 1975. Firm figures were not available, but production of 100 billion cubic meters annually should be achieved before 1980. Natural gas is associated with various oilfields, particularly Takang and Taching. Szechwan Province has long been known for natural gas itself, and supply quadrupled in the last decade. Gas was used at two-thirds of Szechwan's steel plants, over 80% of the salt facilities, over 70% of the fertilizer plants, and many cement plants as well. Reportedly, a pipeline to bring Szechwan gas to Shanghai had already reached Ch'angsha. The Chinese were hoping to sell liquefied natural gas from Takang to Japan. There was a rumor that China was thinking of building a large liquefied natural gas plant near Canton.

China had two of the three shale-oil-producing operations in the world, the other being the Estonian facilities in the U.S.S.R. The older operations at Fushun, Liaoning Province, have been deemphasized because of the natural crude oil discoveries. However, the newer operations at Maoming (Mowming), Kwangtung Province, have been often mentioned in the press. Maoming had six shale-oil-retorting plants,[24] together producing at least 1.5 million tons of shale oil annually. It had a regular crude oil refinery as well, and a 140-kilometer-long, 1-meter-diameter pipeline from Chanchiang was completed to Maoming near yearend to facilitate processing of crude oil brought in from elsewhere.

The steady increase in oil and gas production in China necessitated the building of pipelines and ports. Szechwan Province had a network of natural gas pipelines, and an important gasline was recently built in Yunnan Province. The first long and large oil pipeline was completed near the beginning of 1974, extending 1,152 kilometers between the Taching oilfield and the port of Ch'inhuangtao; this was subsequently extended to Peking. Another line was later built from Taching to T'iehling and Talien (or Dairen), with a branch line to North Korea. Lesser lines had been constructed from the Takang and Shengli oilfields to nearby markets and ports. Talien had a new oil port, capable of accommodating up to 100,000-ton vessels. All other ports could only handle up to 50,000-ton ships. A concerted program was underway to build up shipping ports and unloading facilities.

Oil-refining and petrochemical capacities were being rapidly expanded to accommodate the new oil and gas coming onstream. Many refineries were being enlarged or newly built, bringing China's total capacity to at least 70 million tons by early 1977. Three prominent refining and petrochemical complexes being built were at Whampoa near Canton, Takang, and Chinshan near Shanghai. All three are probably of a magnitude of 5 million tons per year. Other large refineries were located at Fushun, Taching, Lanchow, Shanghai (an old one), Peking, Shengli, Talien, Chinhsi, Nanking, Anshan, Maoming, Yumen, Tientsin, and Karamai-Tushantzu. Capacity of the Nanking refinery was reportedly doubled from the original 3 million tons per year. At the Peking refinery, five new petrochemical units were placed in operation during 1976. The 1.5-million- to 2.0-million-ton Tushantzu refinery in Sinkiang Uighur Autonomous Region was being substantially expanded, and the Maoming refinery was being enlarged also.

[24] China Reconstructs (Peking). August 1976, pp. 18–19.

The Mineral Industry of Colombia

By Lotfollah Nahai [1]

For Colombia 1976 was a year of sharp economic growth. The gross national product at current prices increased 25% from the 1975 level to $15,218 million (estimated); the corresponding figures at constant prices (1970) were 4.6% and $9,655 million (estimated). Real industrial production increased by an estimated 11% during 1976. The same was not the case with the mineral industry, which had no significant gains in production. Colombia's mineral potential, largely petroleum, coal, nickel and, perhaps, copper and uranium, remained substantially unexploited. However, development prospects have improved, and the Government is giving attention to petroleum, coal, and nickel development, in that order.

Of importance to the investment climate was the adoption of the liberalized Andean code on investment, raising the allowable remittance on profits to leave Colombia from 14% to 20% and higher if necessary.

Government action in the minerals area concerned the price of petroleum and a national policy for coal. Prices for new petroleum, which were controlled well below world levels, were raised in May 1976 to world prices c.i.f. Cartagena. A nationwide policy for coal was adopted, and contracts were made to develop coal reserves in association with Exxon Corp. and Spanish and Brazilian entities.

The mineral industry reportedly accounts for 2.5% of the gross domestic product and employs 73,000 people. Coal mining with 15,000 is the largest single employer in the mining sector.[2]

Results of prospecting in collaboration with the United Nations Development Program and the Institute of Geological and Mineral Investigation (Ingeominas) were not announced during the year. This 3-year program will concentrate on detailed examination of copper, lead, and zinc prospects in Western Cordillera.

PRODUCTION

There was little change in the level of output of most minerals other than petroleum, which showed a decline. The production of precious metals was mixed, with silver increasing and gold and platinum declining.

[1] Physical scientist, International Data and Analysis.

[2] Mining Journal. June 1977, p. 376.

Table 1.—Colombia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Chromite, gross weight [e]	12,000	[r] 10,000	10,000
Copper, mine output, metal content	(2)	(2)	--
Gold, troy ounces	265,195	308,709	297,861
Iron and steel:			
Iron ore and concentrate, thousand tons	510	595	498
Pig iron, do.	[r] 269	296	286
Ferroalloys	300	1,000	[e] 1,000
Crude steel, thousand tons	[r] 333	391	360
Semimanufactures, hot-rolled, do.	[r] 280	301	300
Lead, mine output, metal content	126	114	126
Manganese ore, gross weight	6,000	14,000	[e] 14,000
Mercury, 76-pound flasks	79	(2)	--
Platinum-group metals, troy ounces	21,094	22,114	[e] 16,000
Silver, do.	[r] 75,292	83,331	106,000
Zinc, mine output, metal content	37	7	60
NONMETALS			
Asbestos	--	--	[e] 5,000
Barite	2,500	3,000	[e] 3,000
Cement, hydraulic, thousand tons	[r] 3,484	3,154	3,622
Clays:			
Bentonite	998	1,000	[e] 1,000
Kaolin [e], thousand tons	105	105	110
Other [e], do.	715	750	NA
Diatomite	550	600	[e] 600
Feldspar	[r] 22,400	43,000	72,000
Fertilizer materials:			
Crude, phosphate rock	12,000	13,000	[e] 15,000
Manufactured (gross weight):			
Nitrogenous	[e] 120,000	NA	NA
Phosphatic	[e] 60,000		
Other, including mixed	[e] 350,000		
Gypsum, thousand tons	[r] 313	372	621
Lime, do.	[r e] 5,000	7,800	[e] 8,000
Magnesite	1,700	785	[e] 800
Mica, all grades	(2)	(2)	--
Precious and semiprecious stones, emeralds:			
Gem stones, thousand carats	[e] 1	--	--
Morralla, do.	[e] 4	--	--
Salt:			
Rock, thousand tons	[r] 793	795	[e] 800
Other, do.	[r] 752	741	[e] 750
Total, do.	[r] 1,545	1,536	[e] 1,550
Sodium and potassium compounds, caustic soda	59,506	58,294	[e] 60,000
Stone and sand:			
Dolomite, thousand tons	[r] 28	30	NA
Limestone, do.	7,620	7,800	
Marble, cubic meters	3,000	3,500	
Sand, not metal bearing	360,000	370,000	
Sulfur:			
From ore	30,612	30,000	[e] 30,000
Petroleum refinery byproduct	[e] 3,000	2,000	2,000
Talc, soapstone, pyrophyllite	800	1,000	[e] 1,000
MINERAL FUELS AND RELATED MATERIALS			
Carbon black [e]	25,000	[r] 21,800	26,300
Coal, all grades, thousand tons	3,600	3,800	[e] 3,800
Coke, all types, do.	400	420	[e] 400
Gas, natural:			
Gross production, million cubic feet	116,634	210,754	117,924
Marketed production, do.	65,792	65,905	66,715
Natural gas liquids:			
Propane, thousand 42-gallon barrels	1,268	2,811	3,041
Butane, do.	718	734	666
Natural gasoline, do.	1,338	1,324	1,094
Total, do.	3,324	4,869	4,801
Petroleum:			
Crude oil, do.	60,867	57,259	53,376
Refinery products:			
Aviation gasoline, do.	467	428	360
Motor gasoline, do.	20,077	21,318	21,037
Jet fuel, do.	2,091	2,445	2,732
Kerosine, do.	3,329	3,355	3,291
Distillate fuel oil, do.	8,439	6,619	7,488

See footnotes at end of table.

Table 1.—Colombia: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
MINERAL FUELS AND RELATED MATERIALS—Continued				
Petroleum—Continued				
Refinery products—Continued				
Residual fuel oil	thousand 42-gallon barrels	17,927	17,496	18,001
Lubricants	do	376	311	339
Other:				
Liquefied petroleum gas	do	1,867	1,753	2,100
Naphtha	do	1,399	NA	NA
Asphalt and bitumen	do	767	554	565
Unspecified	do	2,328	2,393	59
Refinery fuel and losses	do	1,026	1,013	3,112
Total	do	60,093	57,685	59,084

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, coal briquets are also produced, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.

[2] Revised to none.

TRADE

Colombia had a favorable overall trade balance of $125 million in 1976 but a negative balance for petroleum, minerals, and metals. For petroleum alone the trade deficit totaled $33 million. Crude imports ($84.1 million) accounted for 68% of total petroleum imports ($122.6 million).

Table 2.—Colombia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1974
METALS		
Aluminum:		
Oxide and hydroxide		2
Metal including alloys, all forms		461
Antimony:		
Ore and concentrate		160
Metal including alloys, all forms		24
Chromium ore and concentrate		60
Copper:		
Ore and concentrate		80
Sulfate		179
Metal including alloys, all forms		5
Gold:		
Ore and concentrate		436
Metal, unworked or partly worked	troy ounces	69,381
Iron and steel metal		23,608
Lead:		
Ore and concentrate		435
Metal including alloys, all forms		417
Manganese ore and concentrate		2
Mercury	76-pound flasks	1,450
Nickel metal including alloys, all forms		204
Platinum-group metals and silver:		
Waste and sweepings	troy ounces	64
Metals including alloys:		
Platinum group	do	12,700
Silver	do	1,575
Zinc:		
Oxide		28
Metal including alloys, all forms		(1)
Other:		
Oxides, hydroxides, peroxides of metals, n.e.s		21
Ash and residue containing nonferrous metals		106
NONMETALS		
Barite		680
Cement		417,277
Chalk		731
Clays:		
Kaolin		200
Other		(1)
Diatomite		5
Fertilizers, crude and manufactured		22,501
Fluorspar		225
Graphite		3
Magnesite		(1)
Pigments, mineral		1
Precious and semiprecious stones	kilograms	570
Pyrite, crude		(1)
Salt		5
Sodium and potassium compounds, caustic soda		2
Stone, sand and gravel:		
Stone, unspecified		275
Gravel, crushed rock and sand		1
Sulfur, all forms		357
MINERAL FUELS AND RELATED MATERIALS		
Asphalt, natural		431
Carbon black		9,594
Coal including briquets		1,441
Coke		49,968
Hydrogen, helium, rare gases		1
Petroleum:		
Crude	thousand 42-gallon barrels	462
Refinery products:		
Distillate fuel oil	do	15
Residual fuel oil	do	11,162
Lubricants	do	1
Other:		
Mineral jelly and wax	do	285
Unspecified	do	1
Total	do	11,464

[1] Less than ½ unit.

Table 3.—Colombia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974
METALS	
Aluminum:	
Bauxite and concentrate	3,702
Oxide and hydroxide [1]	1,954
Metal including alloys, all forms	16,506
Antimony metal including alloys, all forms	13
Arsenic trioxide, pentoxide, acid	35
Bismuth metal including alloys, all forms	1
Cadmium metal including alloys, all forms	10
Chromium:	
Oxide and hydroxide	88
Metal including alloys, all forms	(2)
Cobalt oxide and hydroxide	12
Copper:	
Copper sulfate	123
Metal including alloys, all forms	11,128
Iron and steel metal:	
Sponge iron, powder, shot	329
Scrap	8,128
Ferroalloys	6,968
Semimanufactures	293,868
Lead:	
Oxide	2,319
Metal including alloys, all forms	4,261
Magnesium metal including alloys, all forms	35
Manganese:	
Ore and concentrate	1,002
Oxide	578
Mercury 76-pound flasks	589
Nickel metal including alloys, all forms	296
Platinum metal including alloys, all forms troy ounces	64
Rare-earth oxides	4
Silver metal including alloys, all forms troy ounces	574,083
Tin metal including alloys, all forms	474
Titanium oxides	1,143
Zinc:	
Oxide	234
Metal including alloys, all forms	8,811
Other:	
Ores and concentrates, n.e.s	520
Oxides, hydroxides, pentoxides of metals, n.e.s	364
Metals including alloys, all forms, n.e.s	21
NONMETALS	
Abrasives, natural, n.e.s.:	
Pumice, emery, natural corundum, etc	273
Grinding and polishing wheels and stones	104
Asbestos	22,095
Boron materials:	
Crude natural borates	3
Oxide and acid	482
Cement	511
Clays, crude, n.e.s.:	
Bentonite	5,238
Fuller's earth	43
Kaolin	5,412
Other	140
Diamond, industrial carats	365,000
Diatomite and other infusorial earth	923
Fertilizer materials, manufactured:	
Nitrogenous	114,369
Phosphatic	76,528
Potassic	83,979
Other	174,717
Fluorspar	50
Graphite, natural	103
Gypsum and plasters	24,041
Magnesite	53
Mica, all forms	246
Pigments, mineral, including processed iron oxides	1,076
Precious and semiprecious stones, except diamond value, thousands	$18
Salt and brine	12
Sodium and potassium compounds, n.e.s	3,200
Stone, sand and gravel:	
Dimension stone	205
Dolomite, chiefly refractory grade	4,404
Gravel and crushed rock	473
Limestone, except dimension	1
Sand, excluding metal bearing	29

See footnotes at end of table.

Table 3.—Colombia: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity		1974
NONMETALS—Continued		
Sulfur:		
Elemental, all forms		26,038
Sulfur dioxide		79
Sulfuric acid		1,352
Talc, steatite, soapstone, pyrophyllite		1,214
Other nonmetals, n.e.s.:		
Crude, n.e.s		3,101
Oxides and hydroxides of magnesium, strontium, barium		10
Bromine, iodine, fluorine		5
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural		60
Carbon black and gas carbon		633
Coal, coke, peat		22
Hydrogen, helium, rare gases		16
Petroleum refinery products:		
Gasoline (including naphtha)	thousand 42-gallon barrels	5
Kerosine	do	1
Distillate fuel oil	do	25
Residual fuel oil	do	(2)
Lubricants	do	23
Other:		
Liquefied petroleum gas	do	(2)
Mineral jelly and wax	do	21
Bitumen and other residues	do	7
Unspecified	do	12
Total	do	94
Mineral tar and other coal–, petroleum–, and gas–derived crude chemicals		59

[1] Includes synthetic corundum.
[2] Less than ½ unit.

COMMODITY REVIEW

METALS

Chromite.—During 1970–72, production averaged 200 tons per year but increased to 12,000 tons in 1973. Since 1974, production has averaged 700 tons to 800 tons per month. Cromitas Ltda. is the only producing company. The deposits are located in Antiqua near Medellin-Reilo-Envigado and San Benito. Total reserves are estimated at 1.5 million tons. The ore is refractory grade with 36% Cr_2O_3.

Copper.—The copper deposits in the Choco Los Patanos and Murindo were turned over to Empresa Colombiana de Minas (ECOMINAS) for promotion. The area's geology indicates porphyry copper deposits, but exploration has been minimal. ECOMINAS plans to issue guidelines during 1977 calling for proposals to explore the area. The guidelines will probably call for an arrangement similar to the Exxon-Empresa Carbones de Colombia (CARBOCOL) association contract. Other attractive copper deposits discovered by Amoco Colombia Oil Co. near the Panamanian border may be opened this year for drilling and feasibility studies.

Gold, Platinum, and Silver.—Gold production declined 3% from 308,709 troy ounces in 1975 to 297,861 troy ounces in 1976. Until 1976, gold production had been increasing steadily at an annual rate of 13% since world prices rose sharply in the early seventies. Most of the production increase had been from small miners. To spur the levels of gold production, the Government recently established an 8% export subsidy and raised the internal price of gold. Platinum, a byproduct of gold dredging, also declined (24%). Gold production is expected to increase in 1977 by about 10%.

It was reported that the British-owned Frontino Gold Mine Co. was in the process of liquidation because of labor problems and shrinking reserves.[3]

Increased silver production in 1976 resulted from the finding of higher grade ores. Over 70% of total production was from small miners.

[3] American Metal Market. V. 82, No. 242, Dec. 15, 1976, p. 8.

Iron and Steel.—According to the United Nations Industrial Development Organization (UNIDO), annual steel consumption averaged 0.7 million tons in 1970–74, 50% of which was met through local production. Apparent consumption for 1974 and 1975 were 798,000 and 637,000 tons, respectively. According to the same source, the steel works at Paz del Rio will be expanded to produce 1 million tons of steel ingot in 1980, and a new plant is also planned. Information on the implementation of the expansion of the Paz del Rio plant is not available.

Nickel.—The Cerro Matoso nickel mining project, with The Hanna Mining Co., Standard Oil of California, and the Government as partners, was held up by financing problems. The $300 million project is to produce about 23,000 tons of ferronickel per year when completed. The Instituto de Fomento Industrial (IFI) has sought a $75 million World Bank loan, but the Bank requested long-term marketing contracts before it would provide financing. Such contracts were not secured in 1976, and the project probably has to seek alternative financing. Final ownership and management of the project may ultimately depend upon the financial package on which it is based.

Uranium.—The Institute of Nuclear Affairs (IAN) has found, with the collaboration of several European entities, uraniferous occurrences, most of them located in the Central and Eastern Cordilleras. IAN has contracted to conduct detailed uranium exploration in Sapatoca, Santander. Westinghouse also entered discussions with IAN to initiate exploration. It is Colombia's desire to develop the uranium as rapidly as possible, but the exploration is in the very earliest stages, and development is many years in the future.

NONMETALS

Asbestos.—Minera Las Brisas S.A. reported that engineering plans for the asbestos mill were being completed. The deposit near Campamento in Antioquia Department reportedly has 8.4 million tons of ore reserves capable of producing 390,000 tons of fiber. Fiber production at 20,000 tons per year is scheduled to begin in 1979.[4]

Phosphate.—No developments were reported on the phosphate deposit explored by Ingeominas with assistance from the United States Agency for International Development.

MINERAL FUELS

Colombia has announced a 10-year plan to attain self-sufficiency in petroleum by 1985. The plan requires the expenditure of $3,000 million for exploration and production, and $800 million for the expansion of refinery capacity and the pipeline network.[5] A new production contract system will allow foreign operators 40% of commercial output from their discoveries.

The use of coal and natural gas is also to be stimulated, especially in the northern part of the country, in order to attain self-sufficiency in mineral fuels.

Coal.—Colombia has the largest coal resources in South America. Yet the development of coal resources has been slow and hampered by the widespread distribution of the deposits together with the mountainous topography, which has resulted in the isolation of the various coalfields as well as the consuming industrialized areas. With few exceptions, past production has been solely to satisfy these internal and isolated markets. Developments in 1976 point to larger scale coal production; the increase in petroleum prices and Colombia's declining petroleum production have made coal a viable alternate energy source.

Using the association contract of Empresa Colombiana de Petróleos (ECOPETROL) as a model for mineral development, a contract was awarded to Exxon for exploration and development of the so-called area B (38,000 hectares) of the Guajira coalfield. This coalfield is located on the coast of the Department of Guajira and has low-sulfur steam coal. Exxon has drilled a number of exploration holes with reportedly good results and is well into the feasibility studies for the port and railroad needed for exploitation of the seams. The amount of the initial investment has been estimated at $350 million, which is to include infrastructure costs—a 125-kilometer railroad to the port of exit and development of harbor facilities.

Area A of the Guajira coalfield, which has been investigated by Peabody Coal Co.,

[4] Asbestos. September 1976, p. 44.
[5] Petroleum Economist. V. 43, September 1976, p. 357.

will revert to CARBOCOL,[6] which was formed in 1976. CARBOCOL will develop the coal on a small scale to produce 1,000 tons per day from surface operations. In the meantime, plans for larger scale production will be prepared to coincide with availability of infrastructures.

The Exxon contract with CARBOCOL has a number of innovations and will serve as a model for future large-scale foreign investments in the mineral industry. International Petroleum Colombia, Ltd. (INTERCOL), Exxon's Colombian coal subsidiary, will undertake all exploration and feasibility, cost, and risk studies over a 3-year period (which can be extended by 1 year). If at the end of the period the project is considered viable, CARBOCOL will pick up half the costs and become half owner. INTERCOL and CARBOCOL will then have 3 years to develop the project. During this period, CARBOCOL may proceed to develop the infrastructure designed by INTERCOL. However, if INTERCOL and CARBOCOL determine that the area is commercially viable, the infrastructure will revert to 50% ownership by INTERCOL and will be operated by it. INTERCOL will pay a royalty of 15% on its half of the coal and can market it as it pleases. In addition to profits and remittance taxes, INTERCOL will pay an increasing share of any profits over 35% of the indexed investment. It will pay on a scale ranging from 2% on the amounts up to $25 million over the basic 35% profit and reaching 90% on amounts up to $250 million or more. The contract has a lifespan of 30 years including the exploration and development period. INTERCOL will operate the mine and transportation facilities and will report to an executive board composed of INTERCOL and CARBOCOL.

In an agreement signed February 7, 1977, Spain committed to carry out coal and uranium exploration in Colombia. After a period of initial exploration, the Spanish can make a proposal for an association contract for detailed exploration and development. The exploration will be in the Sabana area where substantial coking coal (perhaps over 1 billion tons) occurs.

Natural Gas.—Continued delineation drilling of the Texaco Guajira gasfield confirmed that these fields constitute the largest in Colombia with reserves among the largest found to date in South America. Discovery of offshore gas in August by the same company could also add significantly to Colombia's reserves. Limited drilling indicates the potential for 400 million cubic feet of production per day for 20 years. The Cartagena find will be further tested and drilled over the next year. The new discoveries have not yet impacted production, which actually declined slightly from 120,394 million cubic feet in 1975 to 117,541 million cubic feet in 1976.

The gas pipeline from the Guajira Field was inaugurated in August 1976. The pipeline has a capacity of 400 million cubic feet per day from Ballena to Palomino and 200 million cubic feet per day from Palomino to Barranquilla. The two Fields Riohacha and Ballena, with a capacity of 120 million cubic feet per day, will be supplemented in 1978 by the Chucupa Field.

Progress was made during the year in promoting additional development projects based on this gas, when 13 companies submitted proposals for a 150-million-cubic-foot-per-day liquefied natural gas (LNG) facility in the Guajira. These proposals were narrowed down to five which are being studied by ECOPETROL and Texaco. The new gas discoveries could alter the magnitude of this project. Also, at least one 1,000-ton-per-day ammonia plant is planned. The present price of gas is $0.80 per thousand cubic feet.

Petroleum.—Action taken in May 1976 to link new crude oil prices to world prices c.i.f. Cartagena was an important incentive to the industry. Prior to this action, local producers were required to sell their output at unrealistically low prices. This policy resulted in a precipitous decline in exploration drilling and production development in 1975. The May 1976 measure improved the profit situation of local producers. As a result, the rate of decline of old petroleum fields slowed through workovers. There was also a significant increase in exploration (wildcat) and development wells drilled. Further increases in exploration activity in terms of rigs and seismic crews were indicated for 1977; 39 wildcats were scheduled to be drilled in 1977.

[6] The State entities IFI and Ingeominas both have shares in CARBOCOL.

Drilling activity during 1975–77 is summarized[7] in the following tabulation:

	1975	1976	1977 (projected)
Exploration wells	11	21	39
Development wells	13	23	77

In 1976 total footage of exploration and development wells was 186,462 and 201,829 feet, respectively. Eleven of the exploration wells were new-field wildcats, and two of these resulted in discoveries of unproved importance in the Putumayo Basin near the Ecuadorian border. The only other discovery was in the Middle Magdalena Valley. Three Putumayo Fields were put in production—Burdine, Nancy, and Maxine. Burdine and Maxine had an initial production of 3,000 barrels per day. The operating consortium is headed by Farmland International Energy Co.[8]

Of the 23 development wells in 1976, 20 were in the Magdalena Valley fields: 11 in Lisama, Yarigui, and Cantagallo Fields in Middle Magdalena; 7 in Dina, Upper Magdalena; and 2 in Ciuco, Upper Magdalena. Two of the development wells were in the Ballena gasfield, and the last, in Tibu, southwest Maracaibo.

Crude oil production declined about 6.7%. Production by various companies is shown in table 4. Texaco Inc. with its one-half share in Texaco-Petrólera del Rio S.A. (Texaco-Petrório) was the largest producer. All producers except Shell-Condor had lower production than in 1975. Consumption continued to increase resulting in large imports.

The Orito Field of Texaco-Petrório, with a production of 10.8 million barrels, accounted for about one-fifth of the total. The second largest producing field was La Cira of ECOPETROL (5.2 million barrels).

Colombia had a refining capacity of 176,000 barrels per day: 110,000 in ECOPETROL's Barrancabermeja refinery; 50,000 in ECOPETROL's Cartagena refinery; and 15,000 in others. As shown in table 5, domestic production of refined products was not sufficient to meet demand and the country imported about 2.8 million barrels of refined products at a cost of $38.4 million. Crude imports were valued at an additional $84.1 million for a total of $122.6 million. But the country also exported $89.2 million worth of residual fuels. Imports are projected to reach $500 million by 1980.

[7] AAPG Bulletin. V. 61, No. 10, October 1977, pp. 1582–1588, 1594, 1613–1616.
[8] Oil and Gas Journal. Aug. 16, 1976, p. 70.

Table 4.—Colombia: Petroleum production, by company

(Thousand 42-gallon barrels)

	1975	1976	Change (percent)
Antex Oil and Gas Co. Inc	[1] 442	398	−9.9
Chevron Petroleum Co. of Colombia	4,298	4,222	−1.8
Colombia-Cities Service Petroleum Corp. (COLCITCO) [2]	1,869	1,588	−15.0
Petróleos Colombo-Brasileros (COLBRAS)	2,544	2,854	+12.2
Colombia Petroleum Co	4,696	4,408	−6.1
ECOPETROL	9,710	9,680	−.3
Exploraciones Condor S.A. (Shell-Condor S.A.)	5,649	5,885	+4.2
INTERCOL [3]	6,334	6,046	−4.6
Texas (Texpet)	6,573	5,409	−17.7
Texaco-Petrório [4]	15,143	12,283	−18.9
Farmland	--	636	--
Total	57,258	53,409	−6.7

[1] Condensate previously reported as gas production.
[2] Cities Service, ECOPETROL, Amoco, and Arco each own 25%.
[3] Exxon affiliate.
[4] Owned 50% by Texaco and 50% by Petrório. Petrório in turn is owned 50% by ECOPETROL and 50% by Cayman.

Table 5.—Colombia: Salient statistics of the petroleum industry

(Thousand 42-gallon barrels)

	1974	1975	1976
Crude oil:			
Production	60,867	57,259	53,376
Imports	--	--	6,725
Refined products:			
Refinery throughput [1] or production	60,093	57,685	59,084
Imports:			
Gasoline	200	1,773	2,652
Other (distillate, lube, and other)	82	271	121
Total	282	2,044	2,773
Exports: Residual fuels	r 11,162	r 8,691	8,767
Consumption:			
Gasoline	20,744	23,519	24,409
Jet fuel and kerosine	5,470	5,800	6,023
Distillate fuel oil	7,970	6,619	7,528
Residual fuel oil	8,378	8,805	9,244
Lubricants	392	331	359
Other	5,924	4,857	2,735
Refinery fuel and losses	1,026	1,013	3,112
Total	r 49,904	r 50,944	53,410

r Revised.
[1] Total input includes crude runs to stills, plus runs of unfinished oils, topped crude and natural gas liquids blended at refineries.

The Mineral Industry of Cyprus

By E. Shekarchi [1]

In 1976, the island of Cyprus remained divided into two parts by a line running east-west through Nicosia; Turkey controlled the northern sector through the Federated Turkish Cypriots (FCS), and the Government of Cyprus occupied the south. The information in this chapter is based primarily on the Government's report from the south, since no information was available on the northern sector. No major new ore bodies have been reported in Cyprus since the hostilities of 1974.

There were 11 mines in operation, producing asbestos, chromite, iron pyrite and copper and worked by 4 major companies: Hellenic Mining Co. Ltd. (HMC), Cyprus Sulphur & Copper Co. Ltd., Kampia Mines Ltd., and Cyprus Asbestos Mines Ltd. During 1976, the mining sector in Cyprus provided about 11% of the total exports from the island, and 2,300 persons were directly employed in the industry.

The Geological Survey Department (GSD) continued detailed geological mapping, geochemical surveying, and geophysical work in the southern section of the island. Most emphasis was placed on finding new water sources for irrigation of land and water supplies for refugee camps and new housing settlements. Since most of the construction materials needed in the south were located in the northern Turkish zone, supplies of sand and gravel, clay suitable for tile and brick, crushed stone, and other materials were short of demand. The engineering geology and the economic geology sections of GSD concentrated all their efforts in 1976 on finding ample reserves of construction materials to carry out the Government's rebuilding program. The engineering geology section also conducted feasibility studies for the Nicosia-Limassol highway and the initial investigations of various sites under consideration for construction of low-cost housing for refugees. In the field of mineral exploration, GSD's efforts to find new ore bodies in the most promising parts of Cyprus' pillow lava belt continued. The agreement between the Government of Cyprus and Noranda Mines Ltd. of Canada to explore the Pano Lefkara and Mandres prospects by geophysical methods continued in 1976, but no new findings were reported by yearend.

PRODUCTION

Total mineral production in 1976 was about 272,000 tons, compared with 51,000 tons in 1975; the dramatic increase reflected the cessation of hostilities on the island. On a value basis, mineral production had an even better year in 1976, because of higher prices paid on the international market for chromite, asbestos, and pigments. Table 1 shows the available figures on mineral production.

[1] Supervisory physical scientist, International Data and Analysis.

Table 1.—Cyprus: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Chromium ore and concentrate (marketable)	33,753	27,623	9,155
Copper:			
Mine output, metal content [2]	[r] 12,009	9,872	8,000
Cement copper, gross weight	[r] 1,581	--	--
Precipitate copper, gross weight	1,111	--	--
Zinc, mine output, metal content	NA	NA	934
NONMETALS			
Asbestos	[r] 28,086	31,602	34,518
Cement, hydraulic	[r] 338,367	611,453	1,021,726
Clays, crude:			
Bentonite	[3] 4,517	12,193	5,080
Other:			
For brick and tile manufacture ---thousand tons	200	120	102
For cement production ---do	140	196	171
Gypsum:			
Crude	14,541	22,991	54,379
Calcined	5,377	4,929	10,241
Lime, hydrated	61,634	27,082	28,703
Pigments, mineral:			
Terre verte [3]	([4])	3	--
Umber	13,231	4,489	10,200
Yellow ocher	225	--	NA
Salt, marine	3,608	4,432	3,318
Stone, sand and gravel:			
Crushed and broken stone:			
Havara	685,834	655,352	792,519
Limestone:			
For cement production	[r] 236,000	457,251	712,166
Other	6,696	5,527	NA
Marl for cement production	177,340	551,060	651,537
Unspecified building stone	[r] 53,851	48,872	44,706
Dimension stone, marble	39,524	22,150	28,449
Sand and aggregate ---thousand tons	3,216	1,568	2,134
Sulfur: Pyrite ore and concentrate (marketable):			
Gross weight:			
Cupreous	115,329	126,290	119,281
Other	[r] 62,445	79,133	79,019
Total	[r] 177,774	205,423	198,300
Sulfur content:			
Cupreous	[r] 51,597	59,200	55,806
Other	[r] 30,147	39,435	39,194
Total	[r] 81,744	98,635	95,000
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	684	517	644
Jet fuel and kerosine ---do	[r] 279	122	281
Distillate fuel oil ---do	907	772	748
Residual fuel oil ---do	891	463	790
Other:			
Liquefied petroleum gas ---do	155	139	155
Asphalt ---do	70	79	78
Unspecified ---do	367	329	1
Refinery fuel and losses ---do	226	167	179
Total ---do	[r] 3,579	2,588	2,876

[p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, a variety of other crude construction materials are also produced, but information is inadequate to permit formulation of reliable estimates of output levels.

[2] Includes the nonduplicative sum of copper content of all exportable products, including copper concentrate, cupreous pyrites, cement copper, and copper precipitates.

[3] Exports.

[4] Revised to none.

TRADE

Cyprus' foreign trade showed a speedy recovery in 1976 after the serious setback it suffered because of the civil hostilities in 1974. Agricultural products continued to be one of the most important categories of goods exported, accounting for 34% of total exports, and exports of manufactured goods showed an impressive increase in 1976, to 55% of total exports. Exports of minerals declined further and represented 11% of the total, compared with 15% in 1975. While exports of iron pyrites and chromite concentrate decreased, exports of asbestos and cupreous concentrates increased significantly.

Table 2.—Cyprus: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal, scrap	126	155	West Germany 91.
Chromium ore and concentrate	24,845	28,126	West Germany 8,760; Austria 8,359; United Kingdom 4,806.
Copper:			
Concentrate	46,471	39,311	U.S.S.R. 25,409; Spain 10,401.
Cement copper	r 2,354	--	
Cupreous pyrite	23,334	19,778	Italy 7,337; West Germany 4,448.
Metal scrap	346	238	Greece 135; West Germany 81.
Iron and steel metal:			
Scrap	7,292	6,203	Italy 4,110; France 2,079.
Semimanufactures:			
Tubes, pipes, fittings	29	154	Libya 60; Lebanon 32.
Iron castings, rough	2	--	
Lead metal, scrap	254	233	United Kingdom 125.
NONMETALS			
Asbestos, crude	37,166	28,378	United Kingdom 7,938; Denmark 5,439; Greece 3,366.
Cement	39,464	466,504	Syria 319,269.
Clays and clay products, clay and other refractory minerals	6,978	11,512	Israel 6,905.
Gypsum	10,734	20	NA.
Lime	8,283	--	
Pigments, mineral, natural, crude	10,469	4,429	United States 2,974; United Kingdom 703.
Pyrites, unroasted	287,161	408,633	Italy 155,399; Greece 134,814; Turkey 100,515.
Stone, sand and gravel:			
Dimension stone, crude and partly worked, calcareous	--	241	All to Oman.
Gravel and crushed stone	173	110	All to Israel.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products: Distillate fuel oil ----------thousand 42-gallon barrels--	15	--	

r Revised. NA Not available.

Table 3.—Cyprus: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS			
Aluminum metal including alloys, all forms		1,836	767
Copper metal including alloys, all forms		293	149
Gold including platinum plated, unwrought, semimanufactures	troy ounces	3,846	11,020
Iron and steel metal:			
Scrap		--	1
Pig iron, ferroalloys, similar materials		729	568
Steel, primary forms		441	14
Semimanufactures:			
Bars, rods, angles, shapes, sections		57,888	8,035
Universals, plates, sheets		5,704	6,251
Hoop and strip		4,341	186
Rails and accessories		44	2
Wire		2,302	686
Tubes, pipes, fittings		11,061	7,218
Castings and forgings, rough		7	21
Lead:			
Oxides		152	8
Metal including alloys, all forms		97	79
Nickel metal including alloys, all forms		12	7
Platinum-group metals, unwrought and partly worked, but not rolled	troy ounces	--	10
Silver metal:			
Unwrought and partly worked	do	185,437	115,250
Rolled, unwrought and partly worked	do	120	--
Tin metal including alloys, all forms		r 493	469
Titanium oxides		120	111
Zinc:			
Oxide and peroxide		3	2
Metal including alloys, all forms		287	36
Other:			
Ores and concentrates of base metals, n.e.s		--	1
Nonferrous metal scrap, n.e.s		2	2
Oxides of metals, n.e.s		r 50	1
Base metals including alloys, all forms, n.e.s		r $27,248	$6,676
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		20	--
Dust and powder of precious and semiprecious stones	value	$90,470	$61,258
Barite and witherite		38	3
Cement		6,637	2,470
Chalk		365	395
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s		193	140
Products:			
Refractory (including nonclay bricks)	value	$310,221	$885,731
Nonrefractory	do	$1,607,605	$411,838
Diamond, gem, not set or strung	do	$17,495	$16,289
Diatomite and other infusorial earth		42	90
Fertilizer materials:			
Crude:			
Nitrogenous		--	21
Phosphatic		20	6
Potassic		(1)	--
Manufactured:			
Nitrogenous		r 21,888	12,744
Phosphatic		r 1,630	2,208
Potassic		1,199	1,225
Other, including mixed		r 15,369	28,616
Ammonia		14	16
Graphite, natural		1	--
Gypsum and plasters		37	31
Lime		1,498	2,838
Mica, worked, including agglomerated splittings	value	--	$342
Pigments, mineral:			
Natural, crude		898	127
Iron oxides, processed		54	20
Precious and semiprecious stones, except diamond:			
Natural	value	$21,826	$6,829
Manufactured	do	$18,066	$10,389
Salt and brines		349	505
Sodium and potassium compounds, n.e.s.:			
Caustic soda		373	363
Caustic potash, sodic and potassic peroxides		7	(1)

See footnotes at end of table.

Table 3.—Cyprus: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity		1974	1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		1,106	292
Worked	value	$94,941	$15,656
Gravel and crushed rock		304	205
Sand, excluding metal bearing		75	22
Sulfur:			
Elemental, other than colloidal		853	1,581
Sulfur dioxide		121	102
Sulfuric acid, oleum		253	205
Talc, steatite, soapstone, pyrophyllite		4,220	213
Other nonmetals, crude	value	$1,155	$2,974
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		264	152
Coal, anthracite and bituminous		50	101
Coke and semicoke		309	110
Peat, including peat briquets and litter		3	261
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	3,755	2,648
Refinery products:			
Gasoline, including natural	do	163	157
Kerosine and jet fuel	do	162	4
Distillate fuel oil	do	3	45
Residual fuel oil	do	723	1,426
Lubricants	do	49	22
Other:			
Liquefied petroleum gas	do	113	151
Mineral jelly and wax	do	1	1
Bitumen and other residues and bituminous mixtures, n.e.s	do	r 103	93
Unspecified	do	2	(1)
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	value	$67,537	$5,560

r Revised.
1 Less than ½ unit.

COMMODITY REVIEW

METALS

Chromite.—HMC was the sole chromite producer in the country. Production of chromite ore and concentrate was about 9,000 tons, a 67% decrease from the 1975 output. The value decrease of chromite production was less pronounced, owing to higher prices for chromite in the international market. HMC's search for new ore bodies along the ultrabasic belt of the island did not yield promising findings during the year. The bulk of the chromite exports went to the European market, but a small amount was shipped to Japan.

Copper.—Three companies produced copper during the year. HMC operated seven mines and produced 22,000 tons of copper concentrate containing about 20% copper, Cyprus Sulphur & Copper operated an opencast mine and produced about 14,000 tons of copper concentrate at an average grade of 23% copper, and Kampia continued production at its Peristeria and Pitharochoma mines and produced about 2,000 tons of ore containing 20% copper. Since the Kampia mineral dressing plant had not been completed, the company upgraded its ore at HMC's plant. However, Kampia expected to operate its new concentrator in 1977.

Zinc.—Kampia produced about 1,400 tons of zinc concentrate with an average grade of 50% zinc. The company had accumulated a large stockpile of copper-zinc ore pending the erection of a mineral-dressing plant near the Peristeria mine. However, installation of the concentrator was delayed and the company transferred the bulk of its ore to the HMC plant during 1976 for upgrading.

NONMETALS

Asbestos.—Production of asbestos increased substantially in 1976 over the 1975

output. Cyprus Asbestos Mines remained the sole operator and producer on the island. The International Investment Organization (IIO), a member of the International Bank, and Cypriot Pipe Co. signed an agreement in the latter part of 1976 whereby IIO was to finance the construction of a factory for asbestos cement products (high-pressure pipe and asbestos slabs) at Limassol. IIO was to hold 10% of the stock of the company, the Cypriot Government 20%, the Cyprus Development Bank 10%, and Cypriot Pipe Co. 25%; the remaining shares were to be offered to the public. The total cost of the first phase of the project was given as about $4 million [2] and its initial production as about 15,000 tons of various asbestos cement products.

Cement.—Total production of cement was about 1.0 million tons, a 67% increase over the 1975 output. The Cyprus Cement Co. Ltd. and Vassiliko Cement Works Ltd. remained the major producers in 1976. Most of Vassiliko's production was earmarked for export and was very effective in reducing the company's foreign exchange commitments. Syria remained the main importer of Cypriot cement as the result of the contract that was signed between Syria and Vassiliko in 1975 for importation of 4 million tons of cement.

Gypsum.—United Gypsum Ltd. remained Cyprus' main gypsum producer, with a total production of 50,000 tons of crude gypsum and about 8,000 tons of calcined gypsum. The 1976 gypsum production increased 131% over that of 1975, owing to the activity in the construction industry.

Mineral Pigments.—The depressed international market of 1975 gave way to a growing demand for Cypriot pigments in 1976. Total production of terre verte, umber, and yellow ocher was about 10,000 tons in 1976, compared with about 4,000 tons in 1975.

Pyrite.—Pyrite ore and concentrate production in the south decreased 3% in 1976. Sulfur content of Cypriot pyrite, exported primarily to the European market, was close to 50%. The exploration efforts of the GCD to locate new deposits of pyrite continued during the year.

MINERAL FUELS

Offshore oil drilling activity remained minimal since legislation dealing with offshore rights remained uncertain. The Government continued to delay any action on this legislation until the northern and southern sectors could agree on mutually suitable common legislation.

Cyprus Petroleum Refinery Ltd. at Loranca imported about 380,000 tons of crude oil, and petroleum refinery output totaled 380,000 tons, including 100,000 tons of gas oil and diesel oil, 118,000 tons of residual oil, and 76,000 tons of gasoline. The Government held several discussions during 1976 with petroleum-rich Arab countries over the possibility of constructing a second refinery on Cyprus. However, by yearend, no firm decision had been made on a new refinery.

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[2] Where necessary, values have been converted from Cyprus pounds (£C) to U.S. dollars at the rate of £C1 = US$2.44.

The Mineral Industry of Czechoslovakia

By Tatiana Karpinsky [1]

Czechoslovakia is one of the most industrially advanced countries in Eastern Europe. The engineering and metal-processing industries account for one-third of all industrial production. In 1976, Czechoslovakia's share of world production exceeded 1.8%, with only roughly 0.4% of the world's population. For its size, the country had a high share of world output of crude steel (2.2%), bituminous coal (1.5%), and brown coal (9.7%). Czechoslovakia's share of the overall turnover of world trade amounted to 1.1% in 1976.

The national income in Czechoslovakia reached 383,593 million Czechoslovak korunas (Kcs),[2] about 4% more than that of 1975 compared with a planned increase of 5%.[3] In 1976, fuel and energy production accounted for about 6% of the total national income and output of the engineering industry, about 20%.

In 1976, industrial production increased 5.5% and labor productivity 4.9%; in 1975, however, industrial output had increased 7% over that of 1974. In 1976, the first year of the sixth 5-year plan (1976–80), the following percentage increases were reported: Crude steel, 2.6; rolled products, 3.5; cement, 2.7; bituminous coal, 0.5; brown coal and lignite, 3.7; and electrical power, 5.7. Output of nonferrous metals increased moderately.

Czechoslovakia's overall growth rate continued to be the lowest in Eastern Europe. Czechoslovakia is relatively poor in natural resources, but its processing industry is well developed and advanced.

The country has large reserves of coal, antimony, magnesite, mercury, kaolin and other clays, sand for the glass industry, limestone, and building materials, but it is deficient in oil, natural gas, and most metallic ores. To meet the requirements of industry in 1976, imports of raw materials and semifinished products accounted for about 37% of total imports from Council for Mutual Economic Assistance (CMEA) countries.[4] Special emphasis on the conservation of fuel, energy, and raw materials was directed at an overall reduction of 2% to 3% in requirements.

In 1976, Czechoslovakia continued to participate in multilateral projects of the CMEA, including construction of facilities for production of iron ore, construction of an asbestos production complex in the U.S.S.R., construction of a gas pipeline from Orenburg, eastern U.S.S.R., to the western Soviet frontier, and construction of a 750-kilovolt transmission line from Vinnitsa, U.S.S.R., to the Hungarian border. Czechoslovakia joined other CMEA countries in the construction of facilities for the production of nickel in Cuba. For participation in these joint projects, Czechoslovakia is to receive 17 million tons of iron ore, 14,000 tons of asbestos, and 2.8 billion cubic meters of natural gas per year for several years. For its participation in the construction of the 750-kilovolt transmission line, Czechoslovakia's supply of electrical power is to be increased 10%.

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[1] Foreign mineral specialist, International Data and Analysis.

[2] The official exchange rate from Czechoslovak korunas (Kcs) to U.S. dollars in 1976 was Kcs5.775=US$1.00.

[3] Rude Pravo, Prague, Jan. 27, 1977.

[4] Includes the following countries: Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.

Bilateral agreements have led to Czechoslovak geological expeditions in the developing countries, in exchange for deliveries of mineral raw materials.

Like some other CMEA countries, Czechoslovakia typically reserves two-thirds of its total international trade for centrally planned economy countries. In 1976, the country had substantial overall trade deficits with market economy countries; trade with CMEA countries was almost balanced.

Government Policies and Programs.—The basic goal of the 1977 State plan, approved by the Communist Party of Czechoslovakia in April 1976, was to insure the continued development of the national economy and the national income. According to the resolution, the gross national product in 1977 is to increase 5.4% and the national income 5.2%. Industrial production is to increase 5.3%, agricultural production 8.2%, and building construction 6.2%. Fully 90% of the growth in national income is to be achieved by increased labor productivity.

The following percentage increases in production have been planned from 1976 to 1977:

Steel	2.3
Cement	6.3
Fertilizers	3.3
Coal	1.9
Electrical power	6.2

During 1977, production of brown coal is to reach an estimated 92.5 million tons and bituminous coal, 28.1 million tons.

A 6.2% increase in electrical power production is to be achieved by the installation of new generating capacity. In order to achieve the planned output of steel, the ferrous metals industry is to be expanded and modernized. In the heavy engineering sector, production is slated to increase 7.2%, with emphasis on meeting the needs of the foreign trade program. In particular, output of machinery and plant equipment is to be increased. Production of nuclear plant equipment is to be increased 24%.

The most important task in the chemical industry remained the installation of new petrochemical facilities. In the transportation industry, the volume of commodity freight shipments is expected to go up 4.5%. Most solid fuel shipments by rail will be concentrated along the main rail routes leading out of the North Bohemian brown coal basin.

PRODUCTION

In building its industrial base, Czechoslovakia continued to develop the mining industry. Total output of bituminous coal, lignite, and brown coal increased 3.4 million tons since 1975, reaching 118.5 million tons in 1976. Brown coal output accounted for 3.3 million tons of the increase, reaching 86.8 million tons in 1976. The increase in brown coal production was mainly from the North Bohemian Basin, which accounts for approximately three-fourths of the country's production.

In 1976, production of iron ore (1.9 million tons) remained far below expanding national requirements. An additional estimated 15.4 million tons was imported during the year. Production of pig iron totaled 9.5 million tons in 1976, an increase of 0.22 million tons over that of 1975. Crude steel production in 1976 reached 14.7 million tons compared with 14.3 million tons in 1975.

In 1976, total production of refined copper from domestic and imported ore was estimated at 22,052 tons. Continuous production of copper was planned to start on a trial basis at Krompachy in early 1977. According to Czechoslovak sources, annual production of many nonferrous ores is to be increased considerably in the near future, as a result of prospecting.

Crude oil production in 1976 was 0.13 million tons compared with 0.14 million tons in 1975. The rapid increase in output of petroleum products was based on crude oil imported from the U.S.S.R. (17.1 million tons in 1976).

Production of natural gas increased from 929 million cubic meters in 1975 to 937 million cubic meters in 1976. In addition, 4.6 billion cubic meters of gas was imported from the U.S.S.R. In 1976, new deposits of gas with limited reserves were discovered at Dolní Dunajovice in the South Moravian Region and other places.

In 1976, the nonmetallic minerals industry in Czechoslovakia was developing production of magnesite from the Slovak deposits and of kaolin and refractory clays from newly opened deposits. Cement pro-

duction increased 2 million tons to 9.6 million tons in 1976. New deposits of fluorspar were discovered in the Ore Mountains in 1976; Czechoslovakia was expected to be self-sufficient in fluorite by 1985.

In 1976, 62.7 billion kilowatt-hours of electrical energy was produced, an increase of 3.4 billion kilowatt-hours over that of 1975. The electrical power industry was having problems in production and failed to meet plans for the installation of new capacity. To meet the consumption level of electrical energy, additional power was taken from the joint grid of the CMEA countries. The energy situation was strained in Czechoslovakia because electrical power reserves were limited and every power cut affected the pace of overall production. In 1976, eight power stations fueled by brown coal were under construction. Construction of the first 440-megawatt unit of the V–1 nuclear powerplant at Jaslovske Bohunice, which began in 1973, continued in 1976; the unit was expected to be put into operation in 1978.

Table 1.—Czechoslovakia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum:			
Alumina [e]	100,000	100,000	100,000
Aluminum ingot, primary	49,844	43,321	86,019
Antimony:			
Mine output, metal content [e]	750	750	750
Metal [e]	1,400	1,400	1,400
Copper:			
Mine output, metal content	4,700	5,000	5,000
Smelter	6,000	7,000	7,000
Refined, including secondary	20,848	22,824	22,052
Iron and steel:			
Iron ore:			
Gross weight thousand tons	1,688	1,773	1,904
Metal content do	506	532	573
Pig iron and ferroalloys:			
Pig iron do	8,870	9,253	9,474
Blast furnace ferroalloys do	34	28	1
Electric furnace ferroalloys do	127	132	136
Crude steel do	13,640	14,323	14,693
Steel semimanufactures (including castings and forgings) do	9,968	10,411	10,776
Lead:			
Mine output, metal content	3,896	4,105	4,184
Metal, including secondary	17,870	18,447	19,116
Manganese ore, gross weight [2]	973	999	1,100
Mercury 76-pound flasks	5,541	5,918	5,541
Nickel metal, primary [e]	1,500	1,700	1,700
Silver thousand troy ounces	1,300	1,300	1,300
Tin:			
Mine output, metal content	143	176	180
Metal, including secondary	120	107	120
Zinc, mine output, metal content	9,340	8,925	9,269
NONMETALS			
Barite [e]	7,500	7,500	7,500
Cement, hydraulic thousand tons	8,967	9,305	9,552
Clays, kaolin do	484	526	545
Fertilizer materials, manufactured:			
Nitrogenous, N content	405,386	495,627	562,462
Phosphatic:			
Thomas slag, P_2O_5 content	2,848	1,684	--
Other, P_2O_5 content	353,165	396,436	375,666
Fluorspar [e]	90,000	90,000	90,000
Gypsum and anhydrite, crude thousand tons	629	637	660
Lime (quicklime and hydrated lime) do	2,788	2,953	2,986
Magnesite, crude do	634	662	654
Perlite [e]	10,000	10,000	10,000
Pyrite thousand tons	296	149	[e] 190
Salt do	227	230	230
Sodium compounds:			
Caustic soda do	232	258	293
Sodium carbonate, manufactured do	112	121	110
Stone, limestone and other calcareous do	20,693	21,721	22,312

See footnotes at end of table.

Table 1.—Czechoslovakia: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
NONMETALS—Continued				
Sulfur:				
Native	thousand tons	7	10	[e] 10
From pyrite	do	133	67	[e] 85
Byproduct, all sources	do	17	[e] 50	[e] 50
Total	do	157	127	[e] 145
Sulfuric acid	do	1,211	1,245	1,240
MINERAL FUELS AND RELATED MATERIALS				
Carbon black [e]		30,000	30,000	30,000
Coal:				
Bituminous	thousand tons	27,891	28,007	28,139
Brown	do	79,171	83,535	86,838
Lignite	do	3,619	3,551	3,488
Total	do	110,681	115,093	118,465
Coke:				
Metallurgical	do	9,306	9,234	9,007
Unspecified	do	1,592	1,676	1,886
Total	do	10,898	10,910	10,893
Fuel briquets (from brown coal)	do	1,307	1,441	1,311
Gas:				
Manufactured, all types	million cubic feet	274,394	278,879	281,245
Natural, marketed [3]	do	34,432	32,807	33,098
Petroleum:				
Crude:				
As reported	thousand tons	149	142	131
Converted	thousand 42-gallon barrels	1,011	963	888
Refinery products: [4]				
Gasoline	do	11,509	12,172	NA
Kerosine	do	2,062	2,302	2,310
Distillate fuel oil	do	26,766	28,303	29,557
Residual fuel oil	do	47,626	52,661	NA
Lubricants	do	2,366	2,485	NA
Other:				
Liquefied petroleum gas	do	1,427	1,485	NA
Asphalt and bitumen	do	7,539	7,842	NA
Paraffin wax	do	102	126	NA
Total	do	99,397	107,376	NA

[e] Estimate. [p] Preliminary. NA Not available.

[1] In addition to the commodities listed, arsenic, gold, feldspar, graphite, uranium, and a variety of additional petroleum products are also produced, but information is inadequate to make reliable estimates of output levels.

[2] This material, although reported as manganese ore, is believed to be manganiferous iron ore with a manganese content of about 17%, and as such is not equivalent to materials reported elsewhere as manganese ore, which generally contains 25% or more manganese.

[3] Includes gas produced from coal mines; gross output of natural gas is not reported, but it is believed to exceed reported marketed output by a relatively inconsequential amount.

[4] Data presented are for those products reported in official Czechoslovak sources and in United Nations publications; no estimates have been included for other products or for refinery fuel and losses.

TRADE

In 1976, Czechoslovakia's foreign trade turnover (value of exports plus imports) amounted to Kcs108,133 million, an increase of Kcs10,766 million or 11.1% over that of 1975.[5]

In 1976, the total value of exports increased to Kcs52,137 million, an increase of Kcs5,486 million or 11.8% over the 1975 level. Total imports were valued at Kcs55,996 million, an increase of Kcs5,280 million or 10.4% over those of 1975. The balance-of-trade deficit decreased 5.1% from Kcs4,065 million in 1975 to Kcs3,859 million in 1976.

The negative balance of Czechoslovak trade with market economy countries increased to Kcs3,454 million in 1976 from Kcs2,044 million in 1975, owing to a higher deficit in trade with the most advanced Western countries. The trade bal-

[5] Statisticke Prehledy (Statistics Summary), Prague. No. 6, 1977, p. 174.

ance of Czechoslovakia with other centrally planned economy countries improved considerably in 1976, decreasing from Kcs2,021 million in 1975 to only Kcs405 million in 1976.[6]

The State plan for 1977 envisaged a 6.4% increase in foreign trade turnover. Trade with market economy countries is to increase more rapidly (12.2%) than that with other centrally planned economy countries (3%). The plan also called for a greater increase in exports (7.3%) than in imports (5.5%) in order to reduce the unfavorable trade balance. The targets in relation to market economy countries are even higher: Exports are to rise 17.8% and imports 7.5%.[7]

In 1976, the principal trading partner of Czechoslovakia was the U.S.S.R., which accounted for 32.7% of Czechoslovak exports and 32.6% of Czechoslovak imports. The second largest trading partner was East Germany, which accounted for 12.2% of exports and 11.7% of imports. Poland ranked third, with 9.1% of exports and 9% of imports, followed by West Germany, with 5.3% of exports and 5.7% of imports.[8]

In 1976, exports of machinery and equipment accounted for 49.7% of the total national export value; fuels, mineral raw materials, and metals 18.7%; chemical products 4.9%; construction materials 2.1%; and other products 24.6%. The value of machinery and equipment imports amounted to 35.9% of the total import value; fuel, mineral raw materials, and metals 28.9%; chemical products 9.3%; construction materials 1.0%; and other products 24.9%.

Czechoslovakia has trade agreements with many market economy countries. In 1976, more than 130 long-term intergovernmental agreements regulated Czechoslovakia's economic relations with these countries.

The share of trade with developing countries in Czechoslovakia's total foreign trade was about 10%.[9] Czechoslovakia's principal exports to these countries are complete capital investment projects and products of the engineering industry, while its main imports are raw materials. Among the largest and most important orders was the construction of a 3-million-ton-per-year oil refinery at Başzah in Iraq. The contract for the addition of a 3-million-ton-per-year distillation unit was concluded in February 1976.[10]

The major Czechoslovak exports in 1976 included 2.7 million tons of rolled steel, 0.2 million tons of cement, 4 million tons of kaolin, 0.4 million tons of magnesite, 3.8 million tons of bituminous coal, 1.6 million tons of brown coal, and 2.1 million tons of coke. All uranium ore mined in Czechoslovakia was exported to the U.S.S.R.

In 1976, Czechoslovakia's imports from the U.S.S.R. included 12.7 million tons of iron ore, 0.8 million tons of pig iron, 2.9 million tons of bituminous coal, 4.6 billion cubic meters of natural gas, and 16.3 million tons of crude oil. Imports of nonferrous metals were mainly from the U.S.S.R., as well as from Poland, Cuba, the People's Republic of China, Yugoslavia, Iran, and India.

[6] Page 175 of work cited in footnote 5.
[7] Revue Obhodu, Prymyslu Hospodarstyi (Trade Review, Industrial Economics). No. 2, February 1977.
[8] Czechoslovak Foreign Trade, Prague. No. 4, April 1977, p. 48.
[9] Czechoslovak Foreign Trade, Prague. No. 12, December 1976, p. 6.
[10] Czechoslovak Foreign Trade, Prague. No. 9–10, September–October 1976, p. 19.

Table 2.—Czechoslovakia: Exports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Oxide and hydroxide	251	--	
Metal including alloys:			
Scrap	2,143	2,467	Austria 1,766; West Germany 354; United Kingdom 347.
Unwrought and semimanufactures	11,719	11,629	France 2,449; Poland 2,439; West Germany 1,940.
Copper metal including alloys:			
Scrap	866	454	All to West Germany.
Unwrought and semimanufactures	6,168	4,919	West Germany 2,747; Poland 2,172.

See footnotes at end of table.

Table 2.—Czechoslovakia: Exports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Iron and steel:			
Ore and concentrate	73,916	56,995	All to Austria.
Roasted pyrite	9,369	9,238	Do.
Metal:			
Scrap—thousand tons	180	182	Poland 150; Italy 10; Yugoslavia 9.
Pig iron, including cast iron, powder, shot—do	35	22	Yugoslavia 18; Sweden 2.
Ferroalloys—do	20	21	West Germany 11; Austria 3; Hungary 2.
Steel, primary forms—do	384	448	Yugoslavia 183; Italy 76; West Germany 71.
Semimanufactures:			
Bars, rods, angles, shapes, sections [2]—do	1,111	1,072	East Germany 146; Romania 135; Poland 126.
Universals, plates, sheets [2]—do	875	900	West Germany 187; Poland 101; Italy 97.
Hoop and strip [2]—do	243	286	Yugoslavia 84; Poland 35; Egypt 32.
Rails and accessories [2]—do	r 33	35	Romania 9; East Germany 8; Austria 5.
Wire [2]—do	90	101	West Germany 31; Poland 25; Hungary 22.
Tubes, pipes, fittings [2]—do	445	487	U.S.S.R. 374; People's Republic of China 15; East Germany 14.
Castings—do	20	23	Mainly to Poland.
Total—do	r 2,817	2,904	
Lead:			
Ore and concentrate	7,079	7,236	Belgium-Luxembourg 4,833; West Germany 2,403.
Metal including alloys, scrap	92	--	
Magnesium metal including alloys:			
Scrap	658	1,251	Austria 857; West Germany 394.
Unwrought and semimanufactures	85	1,356	All to West Germany.
Manganese oxides	20	--	
Nickel:			
Ore and concentrate	138	--	
Metal including alloys:			
Scrap	478	--	
Unwrought	143	--	
Platinum-group metals including alloys, all forms—value, thousands	$371	$831	All to West Germany.
Tin ore and concentrate	169	181	All to Spain.
Titanium oxides	4,629	2,918	Italy 848; France 693; Sweden 411.
Tungsten ore and concentrate	145	205	All to West Germany.
Zinc:			
Ore and concentrate	17,334	12,729	Belgium-Luxembourg 8,255; Yugoslavia 3,094; West Germany 1,380.
Oxide	1,270	1,578	West Germany 397; Belgium-Luxembourg 390; Italy 310.
Metal including alloys:			
Scrap	337	258	All to West Germany.
Unwrought and semimanufactures	243	--	
Other:			
Ash and residue containing nonferrous metals	1,956	53	All to United Kingdom.
Metals including alloys, all forms—value, thousands	$842	$633	United States $309; Spain $262; Sweden $62.
NONMETALS			
Abrasives, natural: Grinding and polishing wheels and stones	300	--	
Barite	594	--	
Cement, hydraulic [3]—thousand tons	149	106	West Germany 25; Austria 17.
Clays and clay products:			
Crude:			
Kaolin [3]—do	297	296	West Germany 70; Poland 69; Yugoslavia 29.
Unspecified—do	r 342	300	West Germany 126; Hungary 45; Austria 34.

See footnotes at end of table.

Table 2.—Czechoslovakia: Exports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Clays and clay products—Continued			
Products:			
Refractory ----------thousand tons--	r 93	71	West Germany 39; Sweden 17; Hungary 4.
Nonrefractory ----------do----	30	22	Yugoslavia 8; Austria 5; West Germany 4.
Diamond, gem and industrial value, thousands--	$33	--	
Diatomite and other infusorial earth ----------	483	--	
Fertilizer materials:			
Manufactured:			
Nitrogenous ----------	r 173,565	187,321	Hungary 124,743; Yugoslavia 50,718; West Germany 6,163.
Phosphatic ----------	--	190	All to Hungary.
Other, including mixed ----------	130	750	Do.
Ammonia ----------	63,150	17,471	Austria 8,789; Denmark 4,109; West Germany 3,292.
Graphite, natural ----------value, thousands--	$31	--	
Magnesite [3] ----------thousand tons--	400	398	West Germany 79; Hungary 77; Poland 71.
Mica, all forms ----------	r 104	89	Italy 34; West Germany 30; Yugoslavia 25.
Pigments, mineral: Iron oxides, processed ---	1,870	360	All to Italy.
Precious and semiprecious stones, except diamond ----------value, thousands--	$150	$74	All to West Germany.
Sodium and potassium compounds, n.e.s.:			
Caustic soda ----------	445	5,082	Hungary 3,147; Yugoslavia 1,827.
Caustic potash ----------	1,001	759	Yugoslavia 313; Italy 227; Austria 219.
Soda ash ----------	13,500	21,022	Yugoslavia 11,578; West Germany 9,040; Hungary 404.
Stone, sand and gravel:			
Dimension stone, crude and worked -----	r 49,985	98,049	Hungary 66,151; West Germany 31,898.
Gravel and crushed rock ----------	r 11,756	8,216	All to Hungary.
Sand ----------	139,218	142,413	Austria 72,807; Hungary 69,606.
Talc ----------	4,798	4,194	All to Poland.
Other:			
Crude ----------	7,199	7,842	West Germany 5,356; Austria 2,486.
Slag, dross, and similar waste, not metal bearing ----------	46,794	31,412	All to West Germany.
MINERAL FUELS AND RELATED MATERIALS			
Coal: [3]			
Bituminous ----------thousand tons--	3,717	3,666	Romania 804; Austria 654; Yugoslavia 635.
Lignite ----------do----	1,391	1,683	West Germany 1,634.
Coke and semicoke [3] ----------do----	2,519	2,299	East Germany 793; Austria 546; Romania 489.
Gas, natural ----------million cubic feet--	--	178,303	All to Hungary.
Petroleum:			
Partly refined thousand 42-gallon barrels--	30	--	
Refinery products:			
Gasoline ----------do----	941	1,346	Austria 661; France 369; West Germany 166; Hungary 104.
Distillate fuel oil ----------do----	1,196	1,842	Switzerland 1,171; West Germany 646; Hungary 25.
Residual fuel oil ----------do----	--	3	All to Italy.
Lubricants ----------do----	17	29	Austria 27; Yugoslavia 2.
Other:			
Liquefied petroleum gas --do----	52	135	France 105; Yugoslavia 30.
Mineral jelly and wax ----do----	19	21	Italy 14; West Germany 3; France 2.
Nonlubricating oils, n.e.s --do----	r 575	1,234	West Germany 1,229.
Pitch and pitch coke -----do----	r 463	321	West Germany 131; Italy 63; Switzerland 52.
Bitumen and other residues do----	140	30	All to Yugoslavia.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ----------	r 45,356	29,146	West Germany 18,446; Italy 3,714; Switzerland 2,114.

r Revised.

[1] Unless otherwise specified, data are partially or wholly compiled from the 1975 edition of the United Nations World Trade Annual and the 1974 edition of the United Nations Supplement to the World Trade Annual, as well as official trade statistics of selected trading partner countries (Bulgaria, East Germany, Hungary, Poland, Romania, and the U.S.S.R.).

[2] United Nations. Statistics of World Trade In Steel, New York. 1974 and 1975.

[3] Official Czechoslovak Trade Statistics.

Table 3.—Czechoslovakia: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Alumina	12,127	9,083	Hungary 8,975.
Bauxite and concentrate [2] thousand tons	432	451	Hungary 313; Yugoslavia 138.
Metal:			
Scrap	1,714	1,913	All from Austria.
Metal including alloys, unwrought and semimanufactures thousand tons	r 135	2 3 93	U.S.S.R. 80; Yugoslavia 12.
Cadmium metal including alloys, all forms [2]	268	307	United Kingdom 42; West Germany 23.
Chromium, chromite [2] thousand tons	183	178	U.S.S.R. 129; Albania 21; Iran 9.
Copper:			
Ore and concentrate	1,685	1,681	All from France.
Metal including alloys, unwrought and semimanufactures	63,212	2 4 58,000	U.S.S.R. 36,000; Poland 12,000; United Kingdom 5,000.
Iron and steel:			
Ore and concentrate [2] thousand tons	13,985	14,802	U.S.S.R. 12,222; Brazil 659; Liberia 496.
Metal:			
Scrap do	22	60	Poland 31; West Germany 24; Austria 5.
Pig iron [2] do	802	1,108	U.S.S.R. 877.
Ferroalloys do	103	114	U.S.S.R. 113.
Steel, primary forms [5] do	r 29	24	Poland 13; Bulgaria 11.
Semimanufactures: [5]			
Bars, rods, angles, shapes, sections do	86	84	U.S.S.R. 39; Poland 32; Yugoslavia 7.
Universals, plates, sheets do	r 213	264	U.S.S.R. 122; Poland 87; West Germany 32.
Hoop and strip do	10	13	Poland 6; Austria 3; West Germany 2.
Rails and accessories do	2 25	4	Poland 1; Yugoslavia 1.
Wire do	2	2	West Germany 1.
Tubes, pipes, fittings do	r 38	62	France 28; Yugoslavia 15; West Germany 12.
Castings and forgings, rough do	4	3	Yugoslavia 2.
Total do	r 378	432	
Lead:			
Oxides	4,152	4,102	France 3,090; Austria 1,012.
Metal including alloys, all forms [2]	35,000	35,000	U.S.S.R. 25,000; Yugoslavia 6,000.
Magnesium metal including alloys, all forms	1,695	1,152	All from U.S.S.R.
Manganese:			
Ore and concentrate [2] thousand tons	475	456	U.S.S.R. 336; Ghana 39; India 37.
Oxide	100	--	
Mercury 76-pound flasks	203	--	
Molybdenum metal including alloys, all forms value, thousands	$55	$111	All from Austria.
Nickel:			
Matte, speiss, similar materials	--	21	All from Netherlands.
Metal including alloys:			
Scrap	870	211	All from France.
Unwrought and semimanufactures [2]	4,534	5,334	U.S.S.R. 3,882; Cuba 296; Finland 281.
Platinum-group metals and silver:			
Waste and sweepings value, thousands	$76	$914	All from Netherlands.
Metals including alloys:			
Platinum-group do	$842	$510	United Kingdom $399; West Germany $111.
Silver do	r $11,229	$5,936	Yugoslavia $2,423; Netherlands $2,011; Belgium-Luxembourg $1,502.
Tin:			
Oxides	17	21	All from West Germany.
Metal including alloys, all forms	439	2 3,986	United Kingdom 1,452; Bolivia 898; Indonesia 550.
Titanium oxides	1,137	863	West Germany 573; Italy 162; United Kingdom 128.

See footnotes at end of table.

Table 3.—Czechoslovakia: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Tungsten:			
Ore and concentrate	247	32	Netherlands 18; West Germany 14.
Metal including alloys, all forms	3	3	Austria 2; Japan 1.
Zinc:			
Oxide	97	77	All from United Kingdom.
Dust (blue powder)	2,066	2,965	Yugoslavia 2,903; Belgium-Luxembourg 62.
Metal including alloys, unwrought and semimanufactures	56,014	[2] 74,000	U.S.S.R. 22,000; Yugoslavia 16,000; Bulgaria 8,000.
Other:			
Ores and concentrates:			
Of molybdenum, tantalum, titanium, vanadium, zirconium	267	897	West Germany 356; United Kingdom 336; Belgium-Luxembourg 205.
Of base metals, n.e.s	481	518	All from Netherlands.
Oxides, hydroxides, peroxides of metals, n.e.s	235	401	Finland 150; Belgium-Luxembourg 68; Japan 66.
Metals including alloys, all forms:			
Metalloids [6]	903	2,282	Norway 1,402; Switzerland 510; Italy 370.
Base metals including alloys, all forms, n.e.s	169	285	Japan 227; Yugoslavia 25; Finland 18.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	[r] 611	429	Italy 367; United Kingdom 62.
Dust and powder of precious and semiprecious stones—value, thousands	$316	$490	All from Switzerland.
Grinding and polishing wheels and stones	339	396	West Germany 200; Austria 132; Italy 34.
Asbestos [2]	38,826	43,494	U.S.S.R. 31,435; Botswana 9,189; Swaziland 1,374.
Barite and witherite	1,125	--	
Boron materials, oxide and acid	64	335	All from Yugoslavia.
Cement [2] —thousand tons	666	582	U.S.S.R. 386; Romania 133.
Clays and clay products (including all refractory brick):			
Crude	[r] 7,038	8,207	Hungary 6,725; West Germany 1,482.
Products:			
Refractory	[r] 6,896	[8] 10,409	West Germany 4,975; France 2,789; Austria 1,264; Hungary 885.
Nonrefractory	4,954	2,150	Italy 1,900; Greece 250.
Diamond:			
Gem, not set or strung—value, thousands	$1,018	$430	All from United Kingdom.
Industrial —do	$2,499	$1,004	All from Belgium-Luxembourg.
Diatomite and other infusorial earth	606	2,138	Iceland 1,936; Austria 202.
Feldspar and fluorspar	6,145	4,834	Yugoslavia 2,471; West Germany 2,363.
Fertilizer materials, crude and manufactured: [2]			
Nitrogenous (N content)—thousand tons	50	47	All from U.S.S.R.
Phosphatic (P_2O_5 content) —do	387	376	U.S.S.R. 158; Morocco 102.
Potassic —do	591	690	East Germany 508; U.S.S.R. 182.
Graphite, natural	245	330	All from West Germany.
Gypsum and plasters [2] —thousand tons	[r] 27	25	Mainly from East Germany.
Lime	35,910	27,477	All from Poland.
Magnesite	2,588	900	All from Greece.
Mica:			
Crude, including splittings and waste	([9])	196	All from France.
Worked, including agglomerated splittings	--	2	All from Switzerland.
Pigments, mineral: Iron oxides, processed	1,522	1,696	West Germany 1,390; United Kingdom 306.
Precious and semiprecious stones, except diamond:			
Natural —value, thousands	$62	$74	All from West Germany.
Manufactured —do	$56	--	

See footnotes at end of table.

Table 3.—Czechoslovakia: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Pyrite, sulfur content [2] ——thousand tons	57	11	All from U.S.S.R.
Salt:			
Rock	31,973	44,475	All from Poland.
Brine [10]	112,049	124,601	U.S.S.R. 111,308; Poland 13,293.
Sodium and potassium compounds, n.e.s.:			
Caustic soda ——thousand tons	26	22	All from West Germany.
Soda ash [2] ——do	r 170	206	East Germany 77; Romania 53; Bulgaria 39.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	r 26,163	32,002	Yugoslavia 19,691; Hungary 12,311.
Worked	1,437	1,084	All from Yugoslavia.
Limestone and dolomite	13,185	10,387	All from Poland.
Gravel and crushed rock	r 17,889	8,318	All from Hungary.
Quartz and quartzite	5,566	2,799	All from West Germany.
Sand, excluding metal bearing	r 66	--	
Sulfur:			
Elemental, all forms [2] ——thousand tons	329	493	Mainly from Poland.
Sulfur dioxide	376	330	All from West Germany.
Sulfuric acid [2 11] ——thousand tons	76	92	U.S.S.R. 55; Poland 37.
Other:			
Crude	476	1,059	United Kingdom 930; West Germany 129.
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture	6,710	--	
Oxides and hydroxides of magnesium, strontium, barium	410	337	France 241; West Germany 96.
Bromine, iodine, fluorine	62	35	All from United Kingdom.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	19,230	22,645	U.S.S.R. 18,414; United Kingdom 1,880; West Germany 1,626.
Coal and briquets: [2]			
Anthracite and bituminous coal thousand tons	5,168	5,188	U.S.S.R. 2,818; Poland 2,370.
Lignite briquets ——do	546	518	All from East Germany.
Coke and semicoke ——do	76	67	All from U.S.S.R.
Gas, natural ——million cubic feet	r 186,319	130,452	Do.
Hydrogen, helium, rare gases	4	15	All from West Germany.
Petroleum:			
Crude [2] ——thousand 42-gallon barrels	107,714	115,453	U.S.S.R. 113,947; Iraq 1,506.
Refinery products:			
Gasoline ——do	60	355	All from West Germany.
Kerosine and jet fuel ——do	r 8	7	Yugoslavia 4; Hungary 3.
Distillate fuel oil ——do	3	81	Austria 77; Yugoslavia 4.
Residual fuel oil ——do	311	76	Austria 70; Greece 6.
Lubricants [12] ——do	364	295	Austria 267; France 6; Netherlands 4.
Other:			
Liquefied petroleum gas [13] ——do	304	342	All from Austria.
Nonlubricating oils, n.e.s. ——do	20	59	West Germany 54; Austria 5.
Mineral jelly and wax ——do	r 14	7	Mainly from West Germany.
Petroleum coke ——do	44	26	All from West Germany.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	--	494	Do.

r Revised.

[1] Unless otherwise specified, data are partially or wholly compiled from the 1975 edition of the United Nations World Trade Annual and the 1974 edition of the United Nations Supplement to the World Trade Annual, as well as official trade statistics of selected trading partner countries (Bulgaria, East Germany, Hungary, Poland, Romania, and the U.S.S.R.).

[2] Official Czechoslovak Trade Statistics.

[3] Official U.S.S.R., Yugoslav, and Hungarian trade statistics report exports to Czechoslovakia of 97,689 tons, 29,914 tons, and 4,255 tons, respectively, in 1975.

[4] Official U.S.S.R. and Polish trade statistics report exports to Czechoslovakia of 38,910 tons and 14,690 tons, respectively, in 1975.

[5] United Nations. Statistics of World Trade in Steel, New York. 1974 and 1975.

[6] Excludes quantities from Denmark valued at $183,000 in 1974 and $107,000 in 1975.

[7] Excludes quantity valued at $51,000.

[8] Excludes quantity from the United States valued at $182,000.

[9] Excludes quantity valued at $28,000.

[10] Imports from the U.S.S.R. probably include rock salt.

[11] Official U.S.S.R. and Polish trade statistics report exports to Czechoslovakia of 160,618 tons and 92,085 tons, respectively, in 1974 and 111,699 tons and 129,135 tons, respectively, in 1975.

[12] Excludes quantities valued at $421,000 in 1974 and $157,000 in 1975.

[13] Excludes quantities valued at $51,000 in 1974 and $145,000 in 1975.

COMMODITY REVIEW

METALS

Antimony.—In 1976, the estimated metal content of mine output of antimony was 750 tons. Production of antimony is expected to increase 200% by 1980.

Antimony was mined at Dúbrava (Central Slovak Region) and Pezinok near Bratislava (West Slovak Region). In 1976, a new concentration plant came into operation near Dúbrava. Prospecting for new deposits of antimony is to be carried out in the Lesser Tatra Mountains and other areas of Slovakia.[11]

Copper.—Czechoslovakia's copper ores are mined at an annual rate of 0.7 million tons at various locations. Czechoslovakia's largest copper deposits are located in the eastern part of the Slovak Ore Mountains (East Slovak Region) and at Zlaté Hory (Moravia). Copper mining is to be expanded at the Zlaté Hory deposits and at the other mines.

New deposits of copper have been discovered in the area of L'ubietová in the Nízké Tatry Mountains. Plans are to increase domestic copper production more than 100% by 1980 and more than 300% by the year 2000.[12]

Imports of copper metal from the U.S.S.R., Poland, and the United Kingdom supplied the main requirements of Czechoslovak industry. Soviet copper deliveries totaled 41,000 tons and Polish deliveries 13,000 tons in 1976. Imports from the United Kingdom totaled 5,000 tons in 1976. Under a long-term trade agreement, Czechoslovakia was participating in the development of copper production in Poland.

Iron and Steel.—In 1976, Czechoslovakia produced 1.9 million tons of iron ore, an increase of 7.4% over that of 1975 and 19% over that of 1970.[13]

The Czechoslovak steel industry is dependent upon imported iron ore. In 1976, imports totaled 15.4 million tons. About 12.7 million tons or 82% of the total was from the U.S.S.R. The remaining 18% came from Brazil, Sweden, India, Algeria, and Liberia.

The types of iron ore supplied by the U.S.S.R. in 1976 were lump (50.3% to 50.8% iron), sinter (54.4% to 54.8% iron), and concentrate (64.5% to 65.0% iron). Some 4.5 million tons of iron ore concentrate, in the form of pellets, came from the U.S.S.R. in 1976. Czechoslovakia plans to receive 50% of its iron ore in pelletized form from the U.S.S.R. by 1990.[14]

Czechoslovakia's iron ore deposits are located in the Slovak Ore Mountains and in the Central Slovak Region. Total reserves of iron ore were estimated at approximately 400 million tons, with an average iron content of 30% to 35%.[15]

In 1976, pig iron production in Czechoslovakia totaled 9.5 million tons, an increase of 0.22 million tons or 2.4% over that of 1975. All ferroalloys were produced at the Orava ferroalloy works.[16]

Crude steel production increased 2.6% from 14.32 million tons in 1975 to 14.69 million tons in 1976.[17] This was 2.2% of total world production of crude steel. Czechoslovakia's plans for the steel industry are to reduce the number of open hearth facilities and increase the number of oxygen converters, as shown in the following tabulation, giving crude steel production in million tons:

	Actual		Planned	
	1970	1975	1980	1985
Thomas/Bessemer	0.23	0.15	--	--
Open hearth	7.84	9.19	5.08	2.65
Electric	1.34	1.56	2.22	2.64
Oxygen	2.06	3.42	9.00	12.75
Total	11.48	14.32	16.30	18.04

[11] Rude Pravo, Prague. Aug. 17, 1977, p. 2.
[12] Horník a Energetik. July 14, 1977, p. 5.
[13] Statisticka Rocenka Ceskoslovenske Socilisticke Republiky, 1977 (Statistical Annual of the Czechoslovak Socialist Republic, 1977), Prague. 1977, p. 371.
[14] Czechoslovak Foreign Trade, Prague. No. 7, July 1977, p. 33.
[15] United Nations. Survey of World Iron Ore Resources, 1955. Pp. 126–130.
[16] Czechoslovak Foreign Trade, Prague. No. 6, June 1977, p. 35.
[17] Statisticke Prehledy (Statistics Summary), Prague. No. 4, 1977, p. 106.

The share of oxygen-blown steel increased from 18% in 1970 to 24% in 1975 and is expected to reach 55% in 1980 and 71% in 1985.

In 1976, production of rolled steel was 10.78 million tons, a 3.5% increase over that of 1975. Production of steel pipe reached 1.49 million tons. Construction of a new foundry valued at Kcs712 million, with a capacity of 17,000 tons per year, continued at the Precision Engineering Works at Gottwaldov during 1976.[18]

In 1980, the ferrous metals industry is to be expanded and modernized. Pig iron production is to reach 10.5 million tons per year. Steel output is to exceed 16 million tons and output of rolled products is to reach 11.5 million tons.[19]

One of the main targets for the steel industry in the sixth 5-year plan is to concentrate the production of pig iron and steel into fewer, bigger plants.

The construction of large-volume coke oven batteries was planned at New Klement Gottwald Metallurgical Works at Kunčice, using a licensed process bought from the U.S.S.R.[20] Construction of the batteries will result in a reduction in the number of production enterprises. A large-capacity central oxygen plant with a capacity of 70,000 cubic meters of oxygen per hour is to be built during the second half of the sixth 5-year plan period. This plant is to meet the needs of two large metallurgical plants, New Klement Gottwald Metallurgical Works at Kunčice and East Slovak Iron and Steel Works at Kosice. The new oxygen plant will substantially increase the production of pig iron in existing blast furnaces.

Lead and Zinc.—Ore production in Czechoslovakia has been about 0.6 million tons per year in recent years. In 1976, lead-zinc ores were mined at Banská Štiavnica (Slovakia) and also at deep levels of mines at Příbram (Central Bohemian Region) and Kutná Hora (eastern part of the Central Bohemian Region).

In 1976, production of lead in Czechoslovakia was 4,180 tons (metal content) and production of zinc, 9,270 tons (metal content). Production of lead and zinc is expected to increase 200% and 260%, respectively, by 1980.

Imports of lead and zinc from the U.S.S.R. and Yugoslavia supplied the basic requirements of Czechoslovak industry. In 1976, imports of lead totaled 36,000 tons, including 25,000 tons from the U.S.S.R. and 6,000 tons from Yugoslavia. Imports of zinc totaled 63,000 tons, 21,000 tons of which came from the U.S.S.R., 19,000 tons from Yugoslavia, 5,000 tons each from Bulgaria and Finland, and 2,000 tons from Poland.

The Institute of Ore Research in Prague developed the plans for construction of a new lead and zinc ore dressing mill.[21]

Tin and Tungsten.—Tin and tungsten ores were mined in the Ore Mountains at Cínovec (North Bohemian Region) and at Horní Slavkov (West Bohemian Region). The cassiterite ores have a low tin and tungsten metal content. Estimated production of tin metal in 1976 was 120 tons. According to Czechoslovak sources, there are promising deposits of tin ores in Slovakia. Tin imports were estimated at 4,000 tons in 1976.

Uranium.—Czechoslovakia has substantial uranium ore deposits. Uranium production is centered at Hamr-na-Jezere (North Bohemian Region) and Příbram (Central Bohemian Region). Underground and surface uranium mines at Hamr-na-Jezere were first developed in 1966 and have been expanding since that time. Hamr-na-Jezere is expected to become an important uranium mining center.

Data on uranium ore production are unavailable. The deposits of uranium ore at Hamr-na-Jezere are considered relatively large and are expected to last through several decades of exploitation.[22] Since World War II all uranium ore has been exported to the U.S.S.R.

Reportedly, the Czechoslovak uranium industry fulfilled the first quarter plan in 1976 and is expected to fulfill the target set for the full year.[23]

NONMETALS

Cement.—Czechoslovakia has been expanding its cement production capacity; a

[18] Czechoslovak Heavy Industry, Prague. February 1977, p. 23.
[19] Hospodarske Noviny (Economic News), Prague. No. 43, 1976, p. 3.
[20] Czechoslovak Foreign Trade, Prague. No. 1, January 1977, p. 4.
[21] Rude Pravo, Prague. Sept. 22, 1976, p. 4.
[22] Czechoslovak Foreign Trade, Prague. No. 1, January 1977, p. 39.
[23] Horník a Energetik. No. 26, July 1, 1976, p. 3.

total of 9.55 million tons of cement was produced in 1976, a 2.7% increase over the output of 1975. In 1976, Czechoslovakia exported 188,000 tons of cement and imported 630,000 tons, mainly from the U.S.S.R. and Romania.

Construction of the new 1.2-million-ton-annual-capacity Prachovice cement plant in the East Bohemian Region continued in 1976. Construction was scheduled to be completed in 1980. The cost of the Prachovice cement plant was reported to be almost Kcs2 billion.[24]

Construction of a new 184-meter-long rotary kiln at the Maloměřice cement works at Brno with a capacity of 1,200 tons of clinker neared completion in 1976. Trial operations were planned for the beginning of 1977.

Under a 1976 agreement between Czechoslovakia and Afghanistan, a cement plant with a projected capacity of 700 tons per day of cement is to be built in the Afgan town of Herāt. The contract was valued at $22 million and falls within the framework of agreements between the two countries on economic, scientific, and technical cooperation. This is typical of Czechoslovakia's practice of exporting large industrial projects to developing countries.[25]

Fertilizer Materials.—Czechoslovakia's chemical industry produced 562,462 tons of nitrogenous and 375,666 tons of phosphatic fertilizers (nutrient content) in 1976. Production of nitrogenous fertilizer increased 13.5% over that of 1975. Production of phosphatic fertilizer decreased 5.6%.

In 1976, consumption of pure nutrients per hectare of agricultural land reached 236 kilograms. By 1980, Czechoslovakia plans to use 268 kilograms and by 1990, about 350 kilograms (nutrient content) of fertilizer per hectare. Czechoslovakia's production of nitrogenous and phosphatic fertilizers provides approximately 70% of the country's consumption; fertilizers continued to be imported from the U.S.S.R., African countries, and East Germany.

Nitrogenous fertilizer was produced at the Lovosice-Záluží chemical complex (North Bohemian Region), at the new chemical complex at Šal'a (West Slovak Region) at a rate of 450,000 tons per year, and at the chemical complex at Strážske (East Slovak Region). The new chemical complex at Šal'a makes nitrogenous fertilizer from natural gas. The important chemical complex at Strážske is expanding its variety of products with the availability of Soviet natural gas.

Phosphatic fertilizer was produced at the chemical complexes at Lovosice (North Bohemian Region), Přerov (North Moravian Region), Kolín and Ústí (Central Bohemian Region), and Bratislava (West Slovak Region). There are plans to build six ammonium polyphosphate plants, each with a capacity of 100,000 tons per year, in the near future.

Plans were made to start construction of a 360-ton-per-day ammonia unit and a 300,000-ton-per-year urea unit, both at Ostrava (North Moravian Region) in 1981. Production of phosphatic fertilizer at the Přerov complex was expected to increase considerably after completion of the new sulfuric acid line in September 1978.[26]

Magnesite.—Production of magnesite ($MgCO_3$) was approximately 0.7 million tons in 1976. Exports of magnesite to Hungary, West Germany, Poland, East Germany, and Romania totaled approximately 0.4 million tons. Substantial deposits of magnesite are located between Lučenec and Kosice in Slovakia. Deposits of amorphous magnesite are found in the South Bohemian Region.

MINERAL FUELS

Coal, mostly brown coal and lignite, has been the major source of primary energy in Czechoslovakia. Total production of primary energy derived from fossil fuels and hydroelectrical power and nuclear power generation increased from 82.2 million tons of standard coal equivalent in 1975 to 84.5 million tons in 1976. In 1976, the share of coal (bituminous, brown, and lignite) in total primary energy production was about 97.5%, crude oil 0.2%, natural gas 1.5%, and nuclear power and hydroelectrical power 0.7%. Total consumption of primary energy in Czechoslovakia increased from 109.9 million tons of standard coal equivalent in 1975 to 113.6 million tons in 1976. In 1976, coal represented 71.8% of total consumption, crude oil 21.5%, natural gas 5.6%, hydroelec-

[24] Rude Pravo, Prague. Aug. 30, 1977, p. 5.
[25] Czechoslovak Foreign Trade, Prague. No. 1, January 1976, pp. 20–21.
[26] Rude Pravo, Prague. July 1, 1977, p. 2.

Table 4.—Czechoslovakia: Total primary energy balance for 1975 and 1976

(Million tons of standard coal equivalent [1])

	Total primary energy	Coal (bituminous, brown, lignite) and coke	Crude oil and petroleum products	Natural gas	Hydro-electrical power	Nuclear power	Turnover of electrical power with other countries
1975:							
Production	82.2	80.4	0.2	1.1	0.4	0.1	--
Imports	34.7	5.5	23.3	5.1	--	--	0.8
Exports	7.0	6.8	--	--	--	--	.2
Apparent consumption	109.9	79.1	23.5	6.2	.4	.1	.6
1976:							
Production	84.5	82.4	.2	1.3	.5	.1	--
Imports	37.3	5.7	25.7	5.1	--	--	.8
Exports	8.2	6.5	1.5	--	--	--	.2
Apparent consumption	113.6	81.6	24.4	6.4	.5	.1	.6

[1] 1 ton standard coal equivalent (SCE)=7,000,000 kilocalories. Conversion factors used are: Hard coal 1.0, brown coal and lignite 0.6, crude oil 1.47, natural gas (per thousand cubic meters) 1.33, and hydroelectrical and nuclear power (per thousand kilowatt-hours) 0.125.

Sources: Statistical Yearbook of Czechoslovakia, Prague. 1976.
Statisticke Prehledy (Statistics Summary), Prague. No. 6, 1977, p. 170.

trical power 0.4%, nuclear power 0.1%, and imported electrical power 0.5%.

The total primary energy balances for 1975 and 1976 are shown in table 4.

In 1976, Czechoslovakia produced 62.7 billion kilowatt-hours of electrical energy, a 5.7% increase over the 59.3 billion kilowatt-hours (revised) of 1975 instead of the planned 7.2%.[27]

The planned construction of new powerplants with total capacity of 800 megawatts remained unfinished in 1976. As was stated at the third session of the Party Central Committee in September 1976, the planned parameters had not been attained in individual blocks during powerplant construction, particularly of Tušimice II and Dětmarovice, and also of the Nováky powerplants with two 110-megawatt blocks.[28]

Nuclear Energy.—The first A–1-type heavy-water nuclear powerplant at Jaslovske Bohunice was put into operation in 1972 with a target capacity of 150 megawatts.[29]

In 1976, work continued at Jaslovske Bohunice on construction of the second nuclear powerplant (V–1) using 440-megawatt-capacity reactors (Voronezh-type) with a total capacity of 880 megawatts. The first unit (440 megawatts) of the V–1 nuclear plant is to become operational in 1978. The second unit, also with a capacity of 440 megawatts, is to be put into operation in 1979. Preparations were in progress for the construction of two additional 440-megawatt units of a V–2 nuclear plant also at Jaslovske Bohunice.

Coal.—Bituminous coal production in Czechoslovakia has stabilized in recent years at around 28 million tons. In 1976, it amounted to 28.1 million tons.[30] Production is expected to remain at about 28 million tons during the remainder of the 1976–1980 period. More than 65% of the bituminous coal produced in Czechoslovakia is metallurgical quality. In 1976, bituminous coal exports (mainly to Romania, Austria, Yugoslavia, and East Germany) totaled 3.8 million tons; bituminous coal imports, supplied by the U.S.S.R. and Poland, amounted to 5.2 million tons.

In 1976, Czechoslovakia produced a total of 86.8 million tons of brown coal (up 4%) and 3.5 million tons of lower quality lignite. Brown coal exports were 1.6 million tons, and imports were 0.5 million tons. Most of the brown coal exports went to West Germany.

Coke production was 10.9 million tons in 1976, approximately the same level as in 1974 and 1975. About 2.1 million tons

[27] Czechoslovak Foreign Trade, Prague. No. 8, August 1976, p. 14.
[28] Hospodarske Noviny (Economic News), Prague. July 1, 1977, p. 7.
[29] Czechoslovak Heavy Industry. April 1976, p. 30.
[30] Page 170 of work cited in footnote 5.

of coke was exported, mainly to East Germany, Hungary, Romania, and Austria.

There are 12 principal coal mining areas in Czechoslovakia, 5 of which produce bituminous coal, 4 brown coal, and 3 lignite.

The bituminous coal areas, located along the northern border and in the west-central section of the country, are Ostrava-Karviná, Kladno, Plzeň, Trutnov, and Rosice. In 1976, about 86.3% of the bituminous coal came from the Ostrava-Karviná Basin, 8.2% from Kladno, 1.5% each from Plzeň and Trutnov, and 2.5% from Rosice. The calorific value of bituminous coal from the Ostrava-Karviná Basin is estimated at 6,400 to 8,200 kilocalories per kilogram (11,500 to 14,800 Btu per pound) and that from Kladno, 5,300 to 6,300 kilocalories per kilogram (9,300 to 11,100 Btu per pound).[31]

The major brown coal areas are located in Bohemia (North Bohemian Region and Sokolov), with smaller basins in Slovakia (Handlová and Modrý Kameň). In 1976, about 72% of the brown coal came from the North Bohemian Basin, about 21% from the Sokolov Basin, and the remainder from the Handlová and Modrý Kameň Basins. About 86% of the brown coal produced in Czechoslovakia is from strip mines. The calorific value of the brown coal in the North Bohemian Basin is estimated at 3,000 to 4,500 kilocalories per kilogram (5,400 to 8,100 Btu per pound) and in some areas as much as 5,500 kilocalories per kilogram (9,900 Btu per pound).[32]

Lignite is found mainly in the South Moravian Region and the Central Slovak Region (Nováky), with some in the West Bohemian Region. The Nováky Basin produces 1.5 million tons of lignite per year.

Coal production in Czechoslovakia is highly mechanized. In 1976, machine mining of bituminous coal in Ostrava-Karviná accounted for about 90% of the total production of coal in that area. Continuous miners produced about 90.5%, scrapers 1.3%, and plows 8.2%. Hydraulic mining was not used. About 91% of all coal was mechanically loaded. Estimated output per worker of bituminous coal in the Ostrava-Karviná Basin was 517 tons in 1976.

Mechanization at brown coal and lignite strip mines was 100%; 34% was mined by power shovels and 66% by wheel excavators. All of the brown coal and lignite output was mechanically loaded. About 20% of the overburden was removed by power shovels, 67% by wheel excavators, and 13% by chain bucket excavators.[33] Estimated output per worker of brown coal and lignite in strip mines was 3,529 tons in 1976.

Measured, indicated, and inferred reserves of bituminous coal were estimated at 4.2 billion tons (as of December 31, 1971).[34] Reserves in the category of undiscovered-speculative resources were estimated at 5.5 billion tons, and marginal reserves were estimated at 3.4 million tons. Brown coal reserves were estimated at 6.6 billion tons measured, indicated, and inferred, 2.0 billion tons undiscovered-speculative and 4.0 billion tons marginal. Total reserves of lignite were estimated at about 2.2 billion tons, of which 0.3 billion tons were measured, indicated, and inferred.

Czechoslovakia's total consumption of bituminous and brown coal in 1975 (latest data available), by consumer group, is as follows, in percent:

Consumer	Bituminous coal	Brown coal
Electric powerplants	19.7	47.6
Steam for heating and industrial use	19.0	24.4
Coke plants	50.7	--
Coal gas plants	--	3.3
Railroads	1.7	1.0
Households	3.3	9.4
Other	5.6	14.3

Source: Statisticka Rocenka Ceskoslovenske Republiky, 1976 (Statistical Annual of the Czechoslovak Socialist Republic, 1976), Prague. 1976, p. 256.

In 1976, geological investigations continued in the Central Bohemian Region, where the Slaný mine, one of the deepest coal mines in Czechoslovakia, is to be developed. Preparatory work for mining was planned to begin in 1979. After 1990, annual production is to reach 2.5 million tons of coal. The coal seams, with a workable thickness of 5 meters at Slaný, are about 1 kilometer below the surface. In the Ostrava-Karviná Basin, development of the Sverma

[31] Czechoslovatskaya Sotsialisticheskaya Respublika, I. M. Maergoiz (Czechoslovak Socialist Republic, I. M. Maergoiz), Moscow. 1964, p. 231.
[32] Page 236 of work cited in footnote 31.
[33] Page 368 of work cited in footnote 13.
[34] Statisticka Rocenka Ceskoslovenske Socilisticke Republiky, 1972 (Statistical Annual of the Czechoslovak Socialist Republic, 1972), Prague. 1972, p. 272.

coal mine (begun in 1973) continued in 1976, with completion scheduled for 1984. The reserves of this mine are estimated to include 13 million tons of coking coal.[35] During 1977–85, many other coal fields are to be developed, among which are the Čankov (West Bohemian Region), Hodonín (South Moravian Region), and Erenstat-Trojanovice (East Bohemian Region) coal fields.

Development of the brown coal industry in the North Bohemian fields continued during 1976. The new Maxim Gorkiy strip mine at Bilny, with a design capacity of 16 million tons per year, produced 2 million tons of coal. This mine is to play an important role in the development of the entire North Bohemian brown coal basin and is to be a base for the newly constructed power station at Chvaletice. The Marshal Konev mine at Dřínov in the Most area was scheduled to be closed in June 1977 to make room for the open cast Army mine.[36]

At the Sabarovice (North Bohemian Region) lignite mine, a large new excavator of 1,000-cubic-meter-per-hour capacity was put into operation to supply the electric powerplant at Ústí.

Among the most important projects in the West Bohemian Region was preparation for the development of the Jiri-3 open cast mine at Vřesová. Plans for 1976–80 include the following new mining developments in the brown coal industry, with the indicated annual capacities in million tons: Bresno, 3.6; Mercury, 0.8; Maxim Gorkiy, 6.5; Chabrovice, 1.4; and others.

The largest river transshipment point in Europe, which was under construction at Lovosice (North Bohemian Region) in 1976, is to be capable of loading and unloading 35,600 tons of coal per day.

Natural Gas.—Production of natural gas in 1976 was 937 million cubic meters, an increase of 0.9% over that of 1975. In 1976, natural gas imports from the U.S.S.R. were 4.6 billion cubic meters.

A contract for the supply of 4.5 billion cubic meters of natural gas from the U.S.S.R. in 1977 was signed in Prague in December 1976.

Work on the 562-kilometer Czechoslovak section of the Orenburg pipeline between the Soviet towns of Aleksandrov Gay and Sokhranovka continued in 1976. Preparation work also started at two compressor stations—Kalinin in Rostov Oblast and Antipovka in Volgograd Oblast, U.S.S.R. Czechoslovak workers are to construct five compressor stations on the Czechoslovak section. Some 2.8 billion cubic meters of gas per year is to be delivered to Czechoslovakia through this pipeline after 1978.

According to the agreement signed between Czechoslovakia and Iran in November 1976, Czechoslovakia is to receive 3.6 billion cubic meters of Iranian gas by way of the U.S.S.R. over a 20-year period starting in 1981.

Since commencement in 1971 of the operation of the Czechoslovak Transit Gas Pipeline, the total amount of natural gas conveyed through the pipeline from the U.S.S.R. to Western Europe and Czechoslovakia reached 30 billion cubic meters by the end of July 1976. In the first 6 months of 1976, the pipeline carried 7 billion cubic meters of natural gas. The control center of the Transit Gas Pipeline in Prague was still under construction in 1976.

Plans are to complete construction of additional pipelines for the transit of 37 billion cubic meters of natural gas per year in 1980. At the beginning of 1977, preparations are to begin on the construction of a gas pipeline, through which gas is to be delivered across Czechoslovak territory to a Western European consortium which includes Ruhrgas A.G. of West Germany, Gaz de France, and Österreichische Mineralölverwaltung A.G. (OMV) of Austria; the pipeline is to have branches running to Switzerland and Belgium.[37]

Czechoslovakia's indigenous natural gas comes mainly from the South Moravian Region (the northern part of the Vienna oil basin). During the 1976–80 5-year plan, 10 newly discovered deposits of natural gas are to be opened. Total production from the new fields is expected to be 680 million cubic meters of gas during the plan period.[38]

Petroleum.—Crude oil production in Czechoslovakia is relatively insignificant. In 1976, output of crude oil amounted to 131,000 tons, a 7.7% decrease from that of 1975.

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[35] Horník a Energetik. July 2, 1977, p. 1.
[36] Work cited in footnote 26.
[37] Page 18 of work cited in footnote 16.
[38] Supplement to Horník a Energetik, Prague. No. 33, Aug. 18, 1976, and No. 34, Aug. 26, 1976, pp. 1–16.

A total of 17.1 million tons of crude oil was imported in 1976, an increase of 8.2% over that of 1975. According to Czechoslovak sources, imports of crude oil in 1980 are to reach 20 million tons, instead of the originally planned 23 million tons.[39]

Indigenous oil is produced mainly in the southeastern part of the South Moravian Region and in the West Slovak Region, where intensive prospecting work continued in 1976.[40]

Crude oil was delivered from the U.S.S.R. to Czechoslovakia through the Friendship pipeline, which has been in operation almost 15 years. This pipeline starts at Almetevsk, in the Volga-Ural region of the U.S.S.R., and runs through Poland, East Germany, Czechoslovakia, and Hungary. Czechoslovakia participated in the financing of an oil pipeline from an Adriatic seaport in Yugoslavia to Czechoslovakia. Completion of this line is planned for 1978; at that time, Czechoslovakia is to receive 5 million tons of crude oil per year from African and Middle Eastern countries (Egypt, Iraq, Iran, Algeria, and Nigeria).

In 1976, Czechoslovak refineries produced approximately 17 million tons of refined petroleum products, mainly from imported oil. The total capacity of refineries was estimated at 20 million to 21 million tons per year.

The largest refinery in Czechoslovakia, the Slovnaft at Bratislava, had a capacity of about 8.5 million tons per year, and a new plant at Kralupy nad Vltavou had a capacity of about 3 million tons per year. The Slovnaft oil refinery processed about 8 million tons of crude oil in 1976; this was to be increased to 8.5 million tons in 1980. The Kralupy nad Vltavou refinery processed about 2.5 million tons of Soviet oil in 1976 and plans were to process about 3 million tons in 1980. In 1976, a new refinery was under construction in Moravia. The initial annual capacity of this refinery is to be 3 million tons in 1978, to be expanded to 6 million tons in 1980.

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[39] Hospodarske Noviny (Economic News), Prague. No. 49, Dec. 3, 1976.

[40] Czechoslovak Foreign Trade, Prague. No. 7, July 1976, pp. 24, 28.

The Mineral Industry of Denmark and Greenland

By Joseph B. Huvos [1]

In 1976, Denmark and Greenland had to rely almost completely on fuel and mineral imports. Denmark produced modest quantities of crude oil, iron ore, diatomaceous earth, salt, and construction materials. Greenland produced a small amount of lead-zinc ore.

The gross national product (GNP) of Denmark and Greenland, reported as a total, was about $37.6 billion[2] in 1976.[3] The mineral industry's share of the GNP was about 1%. Average employment and contribution of the principal sectors of the mineral industry to the GNP in 1975 and 1976 are shown in table 1.

In 1976, the Danish Steel Works Ltd. commissioned a steel reinforcing bar plant at Helsinge near Frederiksvaerk. New nitrogen-phosphorus-potassium (NPK) fertilizer capacity was commissioned at the Fredericia and Nörresundby plants of Superfos A/S. Oil was found at the discovery well I Ruth in the North Sea, where two new drilling platforms were installed, and Danish North Sea oil leases were renegotiated. In Greenland, a new lead-zinc deposit was discovered at Greenex A/S's Marmorilik concession near Uvkussigsat; Greenmines Ltd. made a feasibility study of an iron ore deposit near Godthaab; and the Danish Government funded the further exploration of its South Greenland uranium ore deposits.

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Danish kroner (DKr) to U.S. dollars at the rate of DKr5.7462=US$1.00 for 1975 and DKr6.0450=US$1.00 for 1976.

[3] U.S. Department of Commerce. Foreign Economic Trends and Their Implications for the United States: Denmark. Internat. Marketing Inf. Ser. Rept. 77-092, August 1977, 7 pp.

Table 1.—Denmark and Greenland: Contribution to the gross national product in 1975 and 1976 and employment in the mineral industry in 1976

	Average 1976 employment (thousand persons)	Contribution to gross national product (million dollars)		
		1975	1976	Change (percent)
Base metal industry	6.5	147	179	+22
Nonmetallic minerals	17.6	389	465	+20
Chemical industry	20.5	1,176	1,380	+17
Total	44.6	1,712	2,024	+18

Source: Danmarks Statistisk (Copenhagen). Economic Trends. No. 1, April 1977, pp. 23, 27.

DENMARK

PRODUCTION

In 1976, production of most mineral products increased. Production of selected mineral commodities in 1974, 1975, and 1976 is detailed in table 2. The following tabulation shows the major producers of commodities in 1976:

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Cement	A/S Ålborg Portland-Cement-Fabrikk, plants at Rördal, Ålborg, F.L. Smidth & Co.	100
Iron and steel	Det Danske Staalvalsevaerk A/S, plant at Frederiksvaerk	95
Lead and zinc	Greenex A/S, mine at Marmorilik, Greenland, Cominco Ltd., Canada	100
Moler	Skarrehage Molaervaerk A/S, plants on islands of Fur and Mors	60
Petroleum	Dansk Undergrunds Consortium, Dan oilfield, Shell (40%), A.P. Moller (30%), Standard Oil of Calif. (15%), Texaco (15%)	100
Petroleum, refined	Gulf Oil Refining A/S, refinery at Stignaes, Gulf Oil, United States	41
Do	Dansk Esso A/S, refinery at Kalundborg, Standard Oil N.J., United States	31
Do	A/S Dansk Shell, refinery at Fredericia, Shell Petroleum, United Kingdom	28
Salt	Dansk Salt Co., mine at Hvornum, Kryolitselskabet Øresund A/S and Koninklijke Zout Ketjen N.V., Netherlands	100

Table 2.—Denmark: Production of mineral commodities

Commodity and unit of measure	1974	1975	1976 p
Cement, hydraulic [1] thousand metric tons	2,492	2,237	2,355
Chalk [1] metric tons	76,358	82,920	88,719
Clays, kaolin, crude and washed e do	23,000	23,000	23,000
Coke, gashouse thousand metric tons	72	83	e 83
Diatomaceous materials:			
Diatomite e do	20	21	21
Moler e do	r 218	r 227	227
Fertilizer materials, manufactured: [1]			
Nitrogenous, gross weight do	68	47	59
Phosphatic, gross weight do	641	417	548
Mixed and unspecified, gross weight do	244	215	336
Iron and steel:			
Iron ore (less than 42% iron), gross weight do	6	13	8
Crude steel [2] do	535	559	722
Steel semimanufactures do	r 461	422	539
Lead metal, secondary (including alloys) [1] do	15	13	19
Lime (quicklime and agricultural) [1] do	171	166	231
Peat: [1]			
Fuel e do	5	--	--
Agricultural and other [1] do	32	35	38
Petroleum:			
Crude thousand 42-gallon barrels	689	1,327	1,492
Refinery products:			
Gasoline do	13,599	12,809	11,863
Jet fuel do	119	28	1
Kerosine do	663	722	866
Distillate fuel oil do	24,287	23,964	25,081
Residual fuel oil do	20,412	16,515	16,242
Lubricants do	32	30	30
Unspecified do	3,757	3,443	3,577
Refinery fuel and losses do	3,206	2,933	3,615
Total do	66,075	60,444	61,275
Salt thousand metric tons	423	244	349
Stone, sand and gravel: [1]			
Dimension stone [3] thousand cubic meters	NA	34	35
Crushed and broken: [4]			
Limestone:			
Agricultural thousand metric tons	1,539	2,028	1,887
Other do	339	267	278
Other thousand cubic meters	11	10	11
Sand:			
Industrial do	1,197	1,461	1,135
Other do	410	666	786

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Sales.

[2] Excludes shipyard production of crude castings.

[3] Includes only granite and gneiss; quantity of other dimension stone is not reported, but sales volume was $258,413 in 1974; $209,878 in 1975; and $332,341 in 1976.

[4] Partial figure; excludes quartz, quartzite and flint, for which the quantities produced are not available. However, sales values were $3,008,909 in 1974; $2,806,898 in 1975; and $377,833 in 1976.

TRADE

In 1976, there was no important change in the trade pattern of Denmark and Greenland. Imports of fossil fuels, the most important commodity group, totaled about 16% of imports; exports of mineral products remained insignificant. The European countries were Denmark's main trading partners. Trade in 1974 and 1975 is shown in tables 3 and 4.

Table 3.—Denmark: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite, including calcined	5,189	18,344	Netherlands 7,835; France 5,707; West Germany 2,449.
Oxide and hydroxide[1]	75	314	People's Republic of China 256.
Metal including alloys:			
Unwrought including scrap	8,993	9,362	West Germany 3,456; Sweden 1,584; Belgium-Luxembourg 1,169.
Semimanufactures	11,391	9,195	Sweden 5,141.
Antimony metal including alloys, all forms	18	3	Norway 2; Venezuela 1.
Chromium, chromite	NA	2	NA.
Cobalt metal including alloys, all forms	12	2	All to West Germany.
Copper metal including alloys:			
Scrap	11,459	7,841	West Germany 7,162.
Unwrought	1,655	556	Sweden 398; United Kingdom 124.
Semimanufactures	5,386	3,574	United Kingdom 1,442; Sweden 1,300; West Germany 379.
Iron and steel:			
Ore and concentrate	6,033	12,056	West Germany 7,206; Netherlands 2,310; United Kingdom 1,679.
Roasted pyrite	22,995	NA	
Metal:			
Scrap	129,642	90,968	Sweden 50,917; Norway 15,464; West Germany 13,738.
Pig iron including cast iron	332	538	Sweden 473.
Sponge iron, powder and shot	303	126	West Germany 63; Netherlands 24; Thailand 12.
Ferroalloys	13	10	Sweden 3.
Steel, primary forms	14,369	1,377	West Germany 613; Norway 408.
Semimanufactures:			
Bars, rods, angles, shapes, sections	93,067	101,221	Sweden 37,436; West Germany 30,385.
Universals, plates, sheets	137,819	140,161	Sweden 85,765; Norway 27,903; West Germany 21,316.
Hoop and strip	15,587	11,183	Sweden 10,593.
Rails and accessories	12,757	NA	
Wire	8,688	7,047	Sweden 2,530; Finland 1,666.
Tubes, pipes, fittings	32,261	30,569	Sweden 16,807; West Germany 3,471.
Castings and forgings, rough	12,876	19,784	Sweden 9,782; West Germany 3,802; Norway 3,144.
Total semimanufactures	313,055	309,965	
Lead:			
Ore and concentrate	485	245	All to West Germany.
Oxides	57	92	Kuwait 57; Saudi Arabia 20.
Metal including alloys:			
Scrap	621	402	West Germany 383.
Unwrought	7,986	5,293	Norway 1,770; United States 625.
Semimanufactures	249	279	Finland 219.
Magnesium metal including alloys, all forms	119	109	West Germany 67; United States 35.
Manganese oxides	103	169	Sweden 167.
Mercury ---76-pound flasks	90	[2]	NA.
Molybdenum metal including alloys, all forms	2	2	All to West Germany.
Nickel metal including alloys, all forms	156	152	West Germany 58; United Kingdom 43; Pakistan 25.
Platinum-group metals and silver:			
Waste and sweepings thousand troy ounces	1,897	1,343	West Germany 884; United Kingdom 301.

See footnotes at end of table.

Table 3.—Denmark: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Platinum-group metals and silver—Continued			
Metals including alloys:			
Platinum group thousand troy ounces	444	3	Netherlands 1.
Silver ---do---	283	267	Finland 88; Norway 60; Netherlands 46; Sweden 35.
Tin metal including alloys:			
Unwrought	1,181	1,150	Hungary 293; Italy 183; Norway 143.
Semimanufactures	92	66	Sweden 26; Norway 19.
Titanium dioxide	629	157	Kuwait 45; Saudi Arabia 40; Sudan 21; Sweden 19.
Zinc:			
Oxide	125	16	Kuwait 13.
Metal including alloys:			
Scrap including blue powder (dust)	3,985	3,465	West Germany 1,358; Norway 649; Belgium-Luxembourg 647.
Unwrought and semimanufactures	458	NA	
Other:			
Ash and residue containing nonferrous metals	4,235	3,364	West Germany 2,339; Sweden 456.
Oxides, hydroxides, and pentoxides of metals, n.e.s	56	19	United Kingdom 11; Norway 7.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	4	3	Mainly to West Germany.
Grinding and polishing wheels and stones	1,716	1,890	Iraq 569; Ethiopia 399; Iran 268.
Asbestos	514	113	Yugoslavia 49; France 20; Sweden 15; Norway 14.
Barite and witherite	167	24	Iceland 13; Yugoslavia 10.
Boron materials, oxide and acid	38	45	Sweden 25; Norway 16.
Cement	179,372	232,443	Iceland 58,286; Nigeria 57,474; Dominican Republic 33,085; Israel 28,111.
Chalk	12,187	13,278	Sweden 6,863; Norway 3,530; Finland 2,132.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s	3,838	3,728	Sweden 1,175.
Products:			
Refractory[3]	48,934	33,134	United Kingdom 7,425; West Germany 5,762.
Nonrefractory	58,905	63,934	West Germany 42,945; Sweden 8,676; Norway 8,224.
Cryolite and chiolite	34,805	21,082	NA.
Diamond:			
Gem, not set or strung—value, thousands	$195	$96	Finland $49; West Germany $14; Sweden $12.
Industrial ---do---	(2)	$12	United Kingdom $5.
Diatomite and other infusorial earth	58,889	60,611	West Germany 38,065; Netherlands 8,059.
Feldspar and fluorspar	21	75	Australia 30; Sweden 25; France 20.
Fertilizer materials:			
Crude:			
Phosphatic	2	NA	
Other	339	316	Sweden 266.
Manufactured:			
Nitrogenous	2,330	64	Sweden 22; Iceland 17.
Phosphatic	74,014	23,924	U.S.S.R. 9,966; Bangladesh 8,573; East Germany 4,942.
Potassic	100	1	NA.
Other including mixed	1,276	10,635	India 10,210.
Ammonia	7,603	77,747	United States 22,940; Turkey 20,205; United Kingdom 16,277; Sweden 10,881.
Graphite, natural	(2)	52	Sweden 45; People's Republic of China 6.
Gypsum and plaster	r 1,255	56	NA.
Lime	20,323	91,005	Sweden 41,434; West Germany 22,631; Norway 20,238.
Magnesite	118	8	NA.
Mica, all forms	120	44	West Germany 18; Yugoslavia 14; Saudi Arabia 9.

See footnotes at end of table.

Table 3.—Denmark: Exports of mineral comodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Pigments, mineral including processed iron oxide	574	277	Finland 120; Yugoslavia 101.
Precious and semiprecious stones, except diamond ---kilograms	104	73	Sweden 24.
Salt	124,536	81,221	Sweden 64,950; Norway 10,907.
Sodium and potassium compounds, n.e.s	376	260	Faroe Islands 189; United Kingdom 30.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	50,476	48,707	West Germany 48,544.
Worked	3,065	5,552	West Germany 4,377; Sweden 924.
Dolomite, chiefly refractory grade	81	88	Senegal 7.
Gravel and crushed rock -thousand tons	2,231	2,072	West Germany 2,038.
Limestone (except dimension)	95,572	67,693	Sweden 39,140; West Germany 20,433; Norway 7,650.
Quartz and quartzite	178	363	Cameroon 161; Sweden 149.
Sand, excluding metal bearing	185,457	209,822	Sweden 157,317.
Sulfuric acid	1,625	4,139	United Kingdom 3,967.
Talc, steatite, soapstone, pyrophyllite	140	30	Iceland 11.
Other nonmetals, n.e.s.:			
Crude	1,498	116	Finland 70; Norway 17; Greenland 16.
Slag, dross, and similar waste, not metal bearing	41,856	27,672	West Germany 23,509; Sweden 2,632.
Oxides and hydroxides of magnesium, strontium, barium	10	1	NA.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	17	97	United Kingdom 40; West Germany 17; Sweden 14; Yugoslavia 10.
Carbon black and gas carbon	78	83	Cameroon 45; Sweden 21; Norway 9.
Coal and coke including briquets	63,071	72,098	Sweden 52,232; Norway 10,703; West Germany 8,190.
Gas, hydrocarbon, liquefied	5,050	10,482	Sweden 5,873; Turkey 1,393; Belgium-Luxembourg 1,225.
Peat including peat briquets and litter	3,123	2,882	Netherlands 1,224; West Germany 773; Norway 362.
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	5,808	2	All to Faroe Islands.
Kerosine and jet fuel ---do	355	791	Sweden 434; Netherlands 318.
Distillate fuel oil ---do	8,094	8,654	Sweden 4,677; United Kingdom 1,611.
Residual fuel oil ---do	3,723	2,711	Sweden 2,045.
Lubricants ---do	166	153	Norway 100; Sweden 27.
Mineral jelly and wax ---do	6	4	Sweden 1.
Other ---do	1,419	1,113	Sweden 532; West Germany 359.
Total ---do	19,571	13,428	
Mineral tar and other coal–, petroleum–, or gas–derived crude chemicals	6,570	7,539	Netherlands 4,304; Norway 1,654; Sweden 1,276.

r Revised. NA Not available.
1 Not including synthetic corundum.
2 Less than ½ unit.
3 Including those of magnesite, diatomite, and other refractory materials.

Table 4.—Denmark: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	3,107	130,418	Surinam 129,016; Guyana 1,397.
Oxide and hydroxide [1]	926	1,446	West Germany 603; Italy 509.
Metal including alloys:			
Scrap	1,117	1,835	Norway 624; Sweden 589; West Germany 519.
Unwrought	6,800	5,008	United Kingdom 890; West Germany 623.
Semimanufactures	53,897	39,573	West Germany 7,413; Norway 6,312; Sweden 6,087; Belgium-Luxembourg 4,402; United States 4,201.
Antimony metal including alloys, all forms	43	11	United Kingdom 9; Sweden 1; People's Republic of China 1.
Cadmium metal including alloys, all forms	6	3	Mainly from Norway.
Chromium:			
Chromite	1,456	842	Finland 463; Republic of South Africa 276.
Oxide and hydroxide	439	472	West Germany 290; France 140.
Cobalt:			
Oxide and hydroxide	10	12	Belgium-Luxembourg 8; Canada 4.
Metal including alloys, all forms	30	13	Belgium-Luxembourg 10; West Germany 3.
Copper metal including alloys:			
Scrap	711	1,450	West Germany 541; United Kingdom 510; United States 274.
Unwrought	5,493	4,512	Belgium-Luxembourg 3,744.
Semimanufactures	31,001	24,399	Belgium-Luxembourg 7,322; Sweden 6,345; United Kingdom 4,558; West Germany 2,751.
Iron and steel:			
Ore and concentrate	6,349	726	Sweden 708.
Roasted pyrite	28,960	30,400	All from Norway.
Metal:			
Scrap	4,347	7,059	Sweden 4,459; West Germany 1,894.
Pig iron including cast iron [2]	71,499	80,573	U.S.S.R. 45,508; West Germany 10,916.
Ferroalloys	14,268	16,892	Norway 13,954.
Steel, primary forms	76,505	72,091	West Germany 24,593; Sweden 22,530; Norway 16,492.
Semimanufactures:			
Bars, rods, angles, shapes, sections [3]	490,950	314,811	West Germany 96,459; Belgium-Luxembourg 58,996; Sweden 52,696; France 49,226.
Universals, plates, sheets	770,456	640,755	West Germany 157,720; Sweden 135,420; Belgium-Luxembourg 72,089.
Hoop and strip	73,825	45,933	West Germany 17,106; Sweden 6,132; Netherlands 5,991; Czechoslovakia 5,226.
Rails and accessories	11,550	16,048	West Germany 6,368; France 4,425; Belgium-Luxembourg 4,098.
Wire	23,817	18,175	West Germany 7,155; Belgium-Luxembourg 6,551; Sweden 2,334.
Tubes, pipes, fittings	201,053	161,056	West Germany 57,020; United Kingdom 28,302.
Castings and forgings, rough	1,393	1,002	West Germany 329; Sweden 247.
Total semimanufactures	1,573,044	1,197,780	
Lead:			
Oxides	841	895	West Germany 320; France 202; East Germany 173; United Kingdom 104.
Metal including alloys:			
Scrap	5,613	6,013	Norway 2,644; United Kingdom 1,104; United States 1,032.
Unwrought	11,470	7,621	Sweden 3,312; United Kingdom 1,328; Canada 1,236.
Semimanufactures	1,032	1,424	West Germany 1,348.
Magnesium metal including alloys, all forms	121	155	Norway 91.

See footnotes at end of table.

Table 4.—Denmark: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Manganese:			
Ore and concentrate	2,891	2,772	People's Republic of China 898; Gabon 775.
Oxides	2,254	1,459	Belgium-Luxembourg 784; Japan 422.
Mercury ---76-pound flasks---	658	406	U.S.S.R. 87; United Kingdom 87; Yugoslavia 58; Sweden 58.
Molybdenum metal including alloys, all forms	17	3	West Germany 1; United States 1.
Nickel:			
Matte	8	3	United States 2.
Metal including alloys:			
Unwrought including scrap	191	262	United Kingdom 200; Canada 59.
Semimanufactures	427	245	West Germany 108; United Kingdom 54; Sweden 25.
Platinum-group metals and silver including alloys, all forms:			
Platinum group---thousand troy ounces---	15	17	Switzerland 6; Netherlands 4; West Germany 3.
Silver ---do---	2,447	1,961	West Germany 739; United Kingdom 547; Switzerland 354.
Tin:			
Oxide	20	2	Mainly from West Germany.
Metal including alloys:			
Scrap	216	149	Switzerland 54; Singapore 26; United Kingdom 17.
Unwrought	756	302	Malaysia 76.
Semimanufactures	84	83	United Kingdom 38; West Germany 31.
Titanium oxides	7,745	5,306	Norway 1,390; United Kingdom 890; Finland 852; Netherlands 616; Japan 492.
Tungsten metal including alloys, all forms	11	9	West Germany 3; Sweden 3.
Zinc:			
Oxide	1,547	2,199	West Germany 1,039; East Germany 360; United Kingdom 256.
Metal including alloys:			
Blue powder including scrap	4,814	1,013	Belgium-Luxembourg 516; Norway 289.
Unwrought	15,083	12,435	Finland 2,911; Norway 2,705; Netherlands 2,151; United Kingdom 2,008; Belgium-Luxembourg 1,864.
Semimanufactures	4,525	4,216	France 2,136; Poland 884; West Germany 759.
Other:			
Ore and concentrate of base metals, n.e.s.	235	521	Finland 472.
Ash and residue containing nonferrous metals	3,822	8,197	West Germany 3,117; Sweden 2,394.
Metals including alloys, all forms:			
Metalloids	495	309	France 167; Sweden 77; Norway 40.
Alkali, alkaline earth and rare-earth metals	182	206	West Germany 134; France 70.
Pyrophoric alloys	6	4	United Kingdom 2; West Germany 1; Austria 1.
Base metals including alloys, all forms, n.e.s	126	NA	
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc.	10,715	7,464	West Germany 5,493; Iceland 1,160.
Dust and powder of precious and semi-precious stones ---kilograms---	9	23	West Germany 13; United States 5; Switzerland 3.
Grinding and polishing wheels and stones	2,216	1,058	Austria 334; West Germany 255.
Asbestos	28,181	24,388	Canada 7,289; Cyprus 5,521; Republic of South Africa 5,245; West Germany 2,804.
Barite and witherite	5,250	5,325	United Kingdom 2,902; West Germany 1,115; Netherlands 1,062.

See footnotes at end of table.

Table 4.—Denmark: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Boron materials:			
Crude natural borates	3,496	4,828	United States 3,651; Netherlands 552.
Oxide and acid	311	270	France 133; United States 84; Turkey 28.
Cement	4,408	5,187	United Kingdom 1,520; West Germany 1,305; Norway 1,294.
Chalk	3,076	4,705	Sweden 2,853; France 908; West Germany 758.
Clays and clay products (including refractory brick):			
Crude clays, kaolin and other clays	58,747	34,981	United Kingdom 25,997; West Germany 3,478.
Products:			
Refractory (including nonclay brick)	37,737	30,348	West Germany 12,141; Austria 6,740; United Kingdom 4,974; Sweden 3,886.
Nonrefractory	62,692	64,145	West Germany 35,501; Italy 12,169.
Diamond:			
Gem, not set or strung—thousand carats	6	13,995	Belgium-Luxembourg 2,740.
Industrial —do—	784	43	United Kingdom 37.
Diatomite and other infusorial earth	4,023	3,869	United States 1,543; Iceland 1,427.
Feldspar, leucite, and nepheline syenite	10,145	9,537	Norway 8,631.
Fertilizer materials:			
Crude:			
Nitrogenous	9,420	4,659	All from Chile.
Phosphatic	350,879	257,668	Morocco 180,323; U.S.S.R. 77,078.
Potassic	225	850	All from West Germany.
Manufactured:			
Nitrogenous	109,096	122,762	Norway 87,239; Netherlands 24,060.
Phosphatic:			
Thomas (basic) slag	100	100	All from West Germany.
Other	(1)	5,343	United States 4,895.
Potassic	247,286	207,177	West Germany 115,135; East Germany 69,916; U.S.S.R. 21,967.
Other including mixed	700,181	607,493	Norway 449,330; West Germany 101,851.
Ammonia	217,878	300,004	West Germany 127,317; East Germany 75,598; Austria 32,995.
Fluorspar	2,368	2,885	United Kingdom 1,929; France 817.
Graphite, natural	364	441	West Germany 271; United Kingdom 107; Sweden 57.
Gypsum and plaster	409,375	276,541	U.S.S.R. 80,384; France 77,230; Poland 73,262; Spain 37,060.
Lime	2,834	21,938	United Kingdom 17,555.
Magnesite	11,371	10,866	Czechoslovakia 5,044; Austria 2,559; Spain 2,042.
Mica:			
Crude including splittings and waste	264	246	Norway 98; United Kingdom 88.
Worked including agglomerated splittings	66	76	Belgium-Luxembourg 42; West Germany 19.
Pigments, mineral:			
Natural, crude	359	356	Cyprus 177; West Germany 78; Austria 40.
Iron oxides, processed	5,940	3,440	West Germany 2,658; Spain 496.
Precious and semiprecious stones, except diamond —kilograms	3,465	3,304	West Germany 1,313; Japan 492.
Pyrite	21,351	36	West Germany 35.
Salt	265,364	122,224	West Germany 69,530.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous (including marble)	3,940	3,220	Sweden 1,983; Italy 967.
Slate	12,255	9,231	Norway 5,317; West Germany 1,693.
Other (granite, gneiss, etc.)	37,758	17,163	Sweden 11,024; Norway 5,468.
Worked, all types	54,813	42,976	Sweden 14,482; Portugal 11,403; West Germany 10,143.

See footnotes at end of table.

Table 4.—Denmark: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Stone, sand and gravel—Continued			
Dolomite, chiefly refractory grades	28,826	22,169	Norway 17,696; West Germany 3,304.
Gravel and crushed rock	530,296	588,312	Sweden 514,277; Norway 67,492.
Limestone (except dimension)	167,906	182,691	Sweden 121,457; Norway 30,175.
Quartz and quartzite	6,063	6,639	Sweden 2,908; West Germany 1,618; Norway 1,556.
Sand excluding metal bearing	154,463	148,864	Belgium-Luxembourg 97,165; Norway 32,443.
Sulfur:			
Elemental, all forms	78,113	69,676	West Germany 68,692.
Sulfur dioxide and sulfuric acid	18,242	5,440	West Germany 1,843; Sweden 248.
Talc, steatite, soapstone, pyrophyllite	13,195	9,365	Norway 5,219; West Germany 2,830.
Other nonmetals, n.e.s.:			
Crude	49,533	50,116	West Germany 41,607; Sweden 5,262.
Slag, dross, and similar waste, not metal bearing	4,675	5,823	Sweden 4,227; United Kingdom 1,141.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	4,621	707	United States 353; West Germany 308.
Carbon black	3,675	3,065	United Kingdom 911; West Germany 827; Sweden 750.
Coal and coke including briquets thousand tons	3,816	4,150	Poland 3,452.
Gas, hydrocarbon, liquefied ——do	105	91	West Germany 21; United Kingdom 21; Netherlands 18; Belgium-Luxembourg 15.
Peat including peat briquets and litter	19,686	14,926	Sweden 9,873; U.S.S.R. 2,799.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	68,988	55,104	Iran 21,315; Saudi Arabia 11,704; Nigeria 6,223.
Refinery products:			
Gasoline ——do	8,917	7,463	United Kingdom 1,887; Netherlands 1,760; Belgium-Luxembourg 1,581.
Kerosine and jet fuel ——do	4,819	7,595	Netherlands 2,031; United Kingdom 1,271; Sweden 915; Belgium-Luxembourg 876.
Distillate fuel oil ——do	29,467	28,236	United Kingdom 7,878; Netherlands 4,879; U.S.S.R. 4,006.
Residual fuel oil ——do	30,902	32,348	Netherlands 7,213; United Kingdom 5,421.
Lubricants ——do	819	634	Netherlands 213; United Kingdom 160; West Germany 120; Sweden 80.
Mineral jelly and wax ——do	141	102	West Germany 63.
Other ——do	1,675	1,379	Netherlands 686; West Germany 511; Sweden 154.
Total ——do	76,740	77,757	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	20,119	13,378	West Germany 2,582; United States 2,441; United Kingdom 1,517.

NA Not available.
[1] Not including synthetic corundum.
[2] Including spiegeleisen, grit, sponge, powder, and shot of iron and steel.
[3] Including wire rod.

COMMODITY REVIEW

Metals.—*Iron and Steel.*—A new reinforcing bar plant (Danstal Armering) was commissioned at Helsinge, near Frederiksvaerk, by the Danish Steel Works Ltd. (DDS) in 1976. DDS, the country's main steel producer, had expanded in 1975 into an all-electric steelmaking operation, enabling it to increase production in 1976 to 690,000 tons of crude steel. Employment increased to 2,676.[4]

Nonmetals.—*Cement and Other Nonmetallic Mineral Products.*—A/S Alborg Portland-Cement-Fabrikk, owned by F. L. Smidth & Co., operated Denmark's four cement plants, located one each at Karlstrup near Copenhagen, Lindholm near Nörresundby, Danmark, and Rordal near Alborg. The company's fifth cement plant, located at Dania near Mariager, was used to process bauxite imported from Surinam and British Guinea into calcined bauxite at a rate of 80,000 tons per year.

Various companies produced a number of nonmetallic minerals. Dansk Salt Co. continued to produce about 320,000 tons per year of rock salt by solution mining from a salt dome at Hvornum near Hobro in north Jutland. Production of building stone, sand, and gravel was estimated at 27.5 million cubic meters, including 4.5 million tons from offshore. Production of chalk and limestone, mined mainly in north and eastern Jutland and southeast Iceland, was about 3.3 million cubic meters, and that of clay, mostly on Bornholm Island, was 1.4 million cubic meters. Production of moler, a tertiary clayey diatomaceous earth, on Fur and Mors Islands was about 183,000 cubic meters; about 8,500 cubic meters of kieselguhr was produced in eastern Jutland. About 300,000 cubic meters of granite, sandstone, and slate and 25,000 tons of kaolin were mined on Bornholm Island. About 273,000 cubic meters of peat for nonfuel use was also mined in the country.

Fertilizer Materials.—In 1976, Superfos A/S, Denmark's largest fertilizer producer, expanded and modernized its Jutland fertilizer plants at Fredericia and Nörresundby; as a result, capacity was nearly doubled for producing NPK fertilizer material. Nitric acid capacity had doubled after completion of a new plant at the same location.[5] The company was cooperating with the German Veba Chemie group in a project to build a 550,000-ton-per-year ammonia plant at Brunsbüttel in Holstein, West Germany. Superfos will receive one-half of the plant's output.

Mineral Fuels.—In 1976, Denmark produced only nominal quantities of crude oil and hydroelectric power, and remained almost completely dependent on imported fuels. Use of alternative energy sources, such as imported coal, natural gas, or the building of a nuclear powerplant remained under study.

Table 5 shows supply and apparent consumption of fuel and power in Denmark and Greenland for 1975 and 1976.

Petroleum.—Refining.—Danish refining capacity was unchanged at 11.6 million tons per year in 1976. Refining facilities include A/S Dansk Shell's Fredericia plant in southeast Jutland (3.2 million tons per year capacity), Dansk Esso A/S's Kalundborg plant in northwest Zealand (3.6 million tons per year capacity), and Gulf Oil Refining A/S's Stignaes plant in southeast Zealand (4.7 million tons per year capacity).

Exploration and Development.—A discovery well, 1 Ruth, 13 kilometers southwest of the Dan Field, tested oil at a depth of 1,600 meters. During the year, there were 11 producing wells, but the total increased to 16 at yearend. Two new drilling platforms were installed in the Dan Field, raising the total to five. The Danish Undergrunds Consortium (DUC) remained the sole concessionaire in the Danish sector of the North Sea. DUC consisted of Shell (40%), A.P. Møller (30%), Standard Oil Co. of Calif. (15%), and Texaco Denmark Inc. (15%). Reserves in the Dan Field were estimated at 43 million tons of oil and 25 billion cubic meters of gas.[6]

The Ministry of Commerce renegotiated oil leases to increase production royalties and taxes and to give the Government a greater share of participation. DUC agreed to stop flaring associated gas at Dan and to submit a plan for utilizing it. The Government estimated that municipal distribution companies will require 3 billion cubic meters of gas in 1985 and 5 billion in 1995.

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[4] Danish Steel Works Ltd. 1976 Annual Report. P. 5.
[5] Superfos A/S. 1976 Annual Report. P. 9.
[6] International Petroleum Encyclopedia. Petroleum Publishing Co., Tulsa, Okla. V. 10, 1977, p. 141.

Table 5.—Denmark and Greenland: Supply and apparent consumption of fuels and power for 1975 and 1976

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products [2]	Hydro-electric power [3]
1975:				
Production [4]	0.2	--	0.2	--
Imports	33.5	4.3	29.0	0.2
Exports	4.0	--	3.9	.1
Apparent consumption	29.7	4.3	25.3	.1
1976: [p]				
Production [4]	.3	--	.3	--
Imports	32.8	4.4	28.1	.3
Exports	4.1	--	3.9	.2
Apparent consumption	29.0	4.4	24.5	.1

[p] Preliminary.
[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Includes some liquid natural gas imports.
[3] Includes foreign trade of all electricity.
[4] Includes only primary energy.

Source: Danmarks Statistisk (Copenhagen). Monthly Bulletin of Foreign Trade. December 1976.

GREENLAND

In 1976, Greenland produced lead and zinc ore and exported crude cryolite from existing stocks. Greenmines Ltd., an exploration subsidiary of Kryolitselskabet Øresund A/S (KØAS), carried out an extensive drilling program in niobium-bearing carbonatite at Quagssiarssuk in South Greenland. The company continued feasibility studies of the Isukasik iron ore deposit east of Godthaab. Efforts to attract participation from European steel producers remained unsuccessful.

The Danish Government, in partnership with the European Economic Community (EEC), allocated funds for a drilling program at a State-owned uranium deposit, located at Kvanefjeld near Narssaq, South Greenland. The program was expected to commence in 1977.

COMMODITY REVIEW

Metals.— *Lead and Zinc.*—In 1976, for the third consecutive year, Greenex A/S operated the Black Angel mine at Marmorilik on the west coast of Greenland. 1976 production totaled 602,000 tons of raw ore containing 5.2% lead and 14.7% zinc; development work was started in the mine's cover zone. Ore reserves at yearend were valued at 3.6 million tons containing 4.9% lead and 13.9% zinc.[7] Exploration on nearby Agpat Island was fruitless, but promising mineralization was found at Uvkussigsat. Greenex was controlled 62% by Vestrgron Mines Ltd., which in turn was controlled 62% by Cominco Ltd. of Canada.

Nonmetals.— *Cryolite.*—KØAS exported 21,850 tons of refined cryolite. The refined product was produced in Copenhagen from raw ore imported from old stocks remaining in Greenland after the closing of the depleted Ivigtut mine.

Mineral Fuels.— *Petroleum.*—In 1976, a single dry hole was drilled in the Davis Straits off the west coast of Greenland in bloc No. 34. The French state-owned oil company, Elf-Erap, was the operator for the TGA-Grepco group, which held the concession. In about 180 meters of water and in favorable weather and iceberg conditions, a depth of 3,700 meters was reached. Plans for 1977 include the drilling of several holes by companies holding licenses in the area.

[7] Greenex A/S. 1976 Annual Report. P. 18.

The Mineral Industry of Egypt

By Candice Stevens [1]

The value of Egypt's mineral production increased to approximately 15% of the 1976 gross national product (GNP) of $14 billion[2] owing largely to augmented petroleum revenues. However, Egypt's general budgetary deficit was estimated at $2.5 billion in 1976, and foreign debts totaled $11.8 billion. Expanded public and private investment in the minerals sector and increased revenues from the Suez Canal and the Arab Oil Pipeline Co.'s Suez-Mediterranean (SUMED) pipeline were expected to aid in Egypt's general economic recovery. The 1976–80 5-year plan forecasted overall development expenditures of $20 billion, with the major share coming from foreign sources. In 1976, a total of approximately $158 million was allocated to three major mineral projects: The Helwân iron and steel complex, the Naj Hammādī aluminum plant, and development of the Abu Tartûr phosphate deposits. The budget also included an allocation of $245 million for oil industry development; an additional $422 million was to be contributed by foreign partners. A mineral resource identification program was to be conducted by the U.S. Geological Survey on behalf of Egypt's General Organization for Geological Research and Mining Projects (GOGRM).

Egypt planned a further liberalization of its foreign investment policies set forth in Investment Law No. 43. Since its enactment in 1974, the law has attracted very little foreign investment in mining aside from the petroleum industry. In addition to granting a number of investment incentives, Law No. 43 protected foreign investors from property nationalization or confiscation and established free zones exempt from exchange control regulations and general taxes. New measures under consideration at yearend would minimize restrictions on holding and using foreign exchange, alter the fixed exchange rate system, establish more flexible employment policies, extend corporate tax holidays, change policies on repatriation of profits, streamline complicated bureaucratic procedures, and make the investment law retroactive to older companies.

Large quantities of foreign aid continued to underpin the Egyptian economy and new pledges of support were received in 1976. The Gulf Organization for Development in Egypt (GODE) was established in August 1976 by Saudi Arabia, Kuwait, the United Arab Emirates, and Qatar to finance Egypt's 5-year plan and provide direct budgetary support. An initial capital outlay of $2 billion was expected to be boosted to $12 billion over a 5-year period. During 1976, GODE planned to back a $250 million loan from the Chase Manhattan Bank. It was estimated that the Gulf States have extended more than $4 billion in aid to Egypt during the past 3 years.

In September 1976, the International Bank for Reconstruction and Development (IBRD), which was estimated to have nearly $700 million in loans outstanding to Egypt, formed a consultative group to coordinate Egyptian aid programs. The group was composed of about 15 countries and agencies including the United States, Japan, Western European countries, the Arab oil countries, and the International Monetary Fund (IMF). The IMF pledged to advance a number of loans totaling $600 million over a period of 3 to 4 years.

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[1] Economist, International Data and Analysis.

[2] Where necessary, values have been converted from Egyptian pounds (£E) to U.S. dollars at the rate of £E1 = US$2.56.

The United States extended $795 million in project aid to Egypt in 1976 and expected to increase its total aid to $1 billion in 1977.

The Egyptian Government and Westinghouse Electric Corporation (United States) signed a letter of intent in 1976 for the provision of a 600-megawatt nuclear powerplant project at a cost of $325 million. The plant was to be provided as part of a 1974 agreement between the United States and Egypt, subject to approval by Congress, for the sale of two nuclear reactors. Woodward Clyde (United States), in collaboration with the Egyptian Atomic Energy Authority, was conducting economic and technical feasibility studies for the power projects. The start of a 6-year construction program for the first station at Sidi Kreir, west of Alexandria, was scheduled for 1977.

Egypt was considering a 50-year-old plan to construct a 10,000-megawatt hydroelectric powerplant in the Qattara depression, which covers an area of 19,500 square kilometers. West Germany was assisting in studies of a scheme to excavate a 76-kilometer maritime canal between the depression and the Mediterranean Sea, flood the area with seawater, and install power-generating machinery. The feasibility study was to be completed in 1977.

Egypt expected to earn more than $350 million from Suez Canal transit fees in 1977. More than 12,000 vessels, paying $200 million in passage and carrying 117 million tons of cargo, passed through the Canal in the year since its opening in June 1975. Egypt received a pledge from a number of regional and international organizations to finance $500 million in foreign exchange costs for deepening and widening the Canal. The expansion was to enable tankers weighing up to 150,000 tons fully loaded, 200,000 tons partially loaded, and 300,000 tons in ballast to transit the Canal. Penta-Ocean Construction Co., Ltd., a Japanese construction company, began expansion of the southern end of the Canal in 1976 under a $171 million contract. At yearend, Penta-Ocean signed a $112.5 million contract to widen and deepen the middle section. The reconstruction of devastated towns along the Canal and the reestablishment of infrastructure was to proceed according to master plans prepared by the British firms Bullen & Partners (for Port Said), Clifford Culpin & Partners (for Ismailia), and Sir William Halcrow & Partners (for Suez).

The construction of a new industrial and mineral port at Dekhela was in the planning stage. The new facility, which would reduce traffic at the overburdened Alexandria port, was expected to accommodate tankers of 160,000 deadweight tons and to double an anticipated initial capacity of 20 million tons per year later. Background studies and development of the master plan were under the supervision of the French Bureau Centre d'Études pour les Équipements d'Outre-Mer in conjunction with White Young and Partners (United Kingdom). Construction was tentatively scheduled to begin in 1978, with first-phase completion in 1980.

PRODUCTION AND TRADE

Petroleum continued as Egypt's major mineral commodity in 1976. Production increased 43% from 84 million barrels in 1975 to 120.2 million barrels in 1976. The return of the Sinai oilfields by Israel in late 1975 accounted for the large increase in output. Approximately 28%, or 33 million barrels, of crude oil production was exported; most of the remainder was processed in domestic refineries. Other key mineral products were phosphate, cement, fertilizer, aluminum, and steel. Egypt also produced smaller quantities of manganese, barite, gypsum, talc, and salt. Minerals produced in Egypt are shown in table 1.

Egypt had an overall balance-of-trade deficit of $3.14 billion in 1976, compared with a $2.54 billion deficit in 1975. However, crude oil exports emerged as a major foreign exchange earner and were valued at approximately $650 million in 1976. With petroleum imports valued at $315 million, Egypt had a $335 million surplus in its oil account, compared with an oil trade deficit of $75 million in 1975. Although the U.S.S.R. remained Egypt's largest trading partner, trade between the United States and Egypt exhibited a significant upward trend. U.S. imports from Egypt increased from $32.8 million in 1975

Table 1.—Egypt: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
METALS				
Aluminum metal		--	2,000	55,000
Chromite		295	240	[e] 240
Iron and steel:				
Iron ore and concentrate	thousand tons	1,032	1,087	1,243
Pig iron	do	496	420	569
Ferroalloys	do	[e] 4	5	[e] 5
Crude steel	do	270	348	457
Semimanufactures	do	[r] 377	436	706
Manganese ore and concentrate		4,947	3,581	4,256
NONMETALS				
Asbestos [2]		283	479	1,096
Barite		274	749	288
Cement, hydraulic	thousand tons	3,264	3,584	3,362
Clays:				
Fire clay	thousand cubic meters	950	([3])	NA
Kaolin		25,840	33,364	28,267
Diatomite		1,600	1,600	327
Feldspar, crude		2,228	850	2,128
Fertilizer materials:				
Crude phosphate rock	thousand tons	507	536	394
Manufactured:				
Nitrogenous (N content)	do	101	125	NA
Phosphatic:				
Thomas slag	do	35	32	NA
Superphosphate	do	464	520	NA
Fluorspar		1,121	2,365	[e] 2,400
Gypsum and anhydrite, crude	thousand tons	[r] 562	600	467
Mica		98	7	[e] 10
Pumice		250	250	[e] 300
Salt, marine	thousand tons	485	621	480
Sodium sulfate, natural		15,710	4,039	NA
Stone, sand and gravel:				
Basalt	thousand cubic meters	[4] 324	[4] 311	243
Dolomite	thousand tons	100	100	NA
Granite:				
Broken	do	20	20	NA
Dimension	cubic meters	500	500	NA
Gravel	thousand cubic meters	1,300	1,300	NA
Limestone and other calcareous, n.e.s	do	5,300	5,300	NA
Marble:				
Marble blocks (including alabaster)	cubic meters	8,000	8,000	NA
Broken and gravel		5,500	5,500	NA
Quartz		9,528	6,470	NA
Sand, including glass sand	thousand cubic meters	3,430	3,430	NA
Sandstone	do	110	110	NA
Stone, n.e.s	do	120	120	NA
Sulfur:				
Elemental byproduct		[r] 3,000	4,000	5,000
Sulfuric acid		30,933	37,255	NA
Talc, soapstone, steatite, pyrophyllite		3,942	4,407	5,636
MINERAL FUELS AND RELATED MATERIALS				
Coke:				
Oven and beehive	thousand tons	555	645	[e] 650
Gashouse and other low temperature coke	do	[e] 30	[e] 30	29
Total	do	585	675	679
Gas, natural:				
Gross production	million cubic feet	49,700	50,600	72,000
Marketed	do	1,500	1,606	13,432
Petroleum:				
Crude	thousand 42-gallon barrels	53,715	84,348	120,180
Refinery products:				
Gasoline and naphtha	do	10,090	11,314	12,521
Kerosine and jet fuel	do	10,400	10,012	11,196
Distillate fuel oil	do	10,720	11,988	12,809
Residual fuel oil	do	18,988	28,425	33,673
Lubricants	do	210	371	--
Other:				
Liquefied petroleum gas	do	708	580	--
Asphalt	do	406	715	818
Unspecified	do	98	--	--
Refinery fuel and losses	do	1,746	1,805	4,279
Total	do	53,366	65,210	75,296

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] Egypt produces some sodium carbonate, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2] Includes vermiculite.

[3] Reported as 253,621 metric tons.

[4] 1974 production includes quantity valued at $2,025,885 and excludes quantity valued at $314,514; 1975 production includes quantity valued at $2,047,951 and excludes quantity valued at $305,025.

Table 2.—Egypt: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Iron and steel metal:		
Pig iron, including cast iron and spiegeleisen	--	97,420
Primary forms	2,474	--
NONMETALS		
Cement	181,002	86,196
Fertilizer materials:		
Crude, phosphatic	120,260	104,670
Manufactured, phosphatic	32,620	26,935
Gypsum	--	7
Salt	14,857	10,151
MINERAL FUELS AND RELATED MATERIALS		
Petroleum:		
Crude ---thousand 42-gallon barrels--	11,255	12,162
Refinery products, distillate fuel oil ---do---	247	1,816

Source: Central Agency for Public Mobilization and Statistics. October 1975 and June 1977.

Table 3.—Egypt: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, all forms	6,963	9,628
Copper metal including alloys, all forms	1,229	3,624
Iron and steel:		
Roasted pyrite	--	7,570
Metal:		
Scrap	73,943	80,855
Pig iron and ferroalloys, including cast iron	37,886	68,821
Primary forms	37,708	68,068
Semimanufactures:		
Bars, rods, angles, shapes, sections	157,316	192,741
Universals, plates, sheets	28,596	75,260
Hoop and strip	19,561	38,577
Rails and accessories	4,612	9,076
Wire	21,481	15,275
Tubes, pipes, fittings	18,654	101,518
Castings and forgings	672	32,025
Lead metal, unwrought and scrap	5,994	15,242
Tin metal, unwrought and scrap	505	353
Zinc metal, unwrought and scrap	3,526	8,363
Other:		
Ores and concentrates	387	730
Metals including alloys, all forms	5	62
NONMETALS		
Asbestos	8,429	5,477
Cement	1,110	103,412
Clays and clay products, including refractory brick:		
Crude	259	15,543
Products, refractory	1,734	11,140
Fertilizer materials, unspecified	518,906	423,853
Pyrite, unroasted	80,719	62,857
Sulfur	2,221	38,130
MINERAL FUELS AND RELATED MATERIALS		
Coal	661,656	1,514,015
Coke	15,422	236,671
Petroleum:		
Crude ---thousand 42-gallon barrels--	266	17,024
Refinery products:		
Gasoline ---do---	4	7
Kerosine ---do---	236	(1)
Distillate fuel oil ---do---	2,866	--
Lubricants ---do---	281	166
Other:		
Liquefied petroleum gas ---do---	996	1,396
Paraffin ---do---	10	22

[1] Less than ½ unit.

Source: Central Agency for Public Mobilization and Statistics. October 1975 and June 1977.

to $130 million in 1976, owing largely to a gain in oil shipments. U.S. exports to Egypt grew in value from $225 million in 1973 to more than $800 million in 1976. In addition to petroleum, important Egyptian mineral exports were phosphate rock, aluminum, iron and steel, and cement.

COMMODITY REVIEW

METALS

Aluminum.—In 1976, the new Naj Hammādī aluminum complex, situated 200 kilometers west of the Red Sea port of Safâga and 200 kilometers north of Aswān, produced approximately 55,000 tons of aluminum. About 10,000 tons was exported to the United Kingdom, West Germany, and the Netherlands. The plant, built with Soviet technical assistance, was expected to reach a full capacity of 170,000 tons by 1980. Approximately 2 billion kilowatt-hours of electric energy was supplied annually by overhead transmission lines from the Aswān power station. Alumina was imported from Guinea and the U.S.S.R. and transferred to Naj Hammādī from Safâga.

The Arab Aluminum Co. was formed in 1976 as a joint venture between Egyptian, Kuwaiti, and U.S. investors, including Tabor Metals Inc. (United States), to construct an aluminum-fabricating plant. After 5 years of operation, the plant was expected to process 8,000 tons of ingot annually for use in the manufacture of a variety of industrial, commercial, and consumer products for domestic use and export. The plant, to be located in Ismailia, was to start production in October 1977.

Iron and Steel.—The United Nations Industrial Development Organization (UNIDO) was sponsoring a study by U.S. Engineers and Consultants, a subsidiary of United States Steel Corporation, of the continuing problems of the Helwân iron and steel complex. The program was to include the installation of a computerized maintenance system for establishing a preventive maintenance schedule. The plant, built in 1958 with Soviet technical assistance, was operating at 50% capacity and averaging 500,000 tons of finished products per year. Iron ore came primarily from the Baharîya Oasis, where reserves were estimated at 195 million tons. Among the problems encountered by the Helwân complex were operational difficulties, including equipment breakdowns and a lack of spare parts, a shortage of trained technicians, and irregularities in the supply of coking coal.

Two sponge iron plants were to be constructed, utilizing natural gas from the Abu Madi and Abū Qīr Fields. The Dekhela plant, situated south of Alexandria, was to have a capacity of 1.6 million tons per year. The $200 million project was to be a joint venture of the Egyptian General Organization for Industrialization (50%), the Japanese firm C. Itoh & Co., Ltd. (25%), the West German firm Korf-Stahl A.G. (15%), and the Brazilian firm Companhia Vale do Rio Doce (10%). A second plant, requiring an investment of $125 million, was to be built at Helwân with an 800,000-ton-per-year capacity.

NONMETALS

Cement.—Egypt's cement production capacity in 1976 was approximately 4 million tons concentrated in four plants, as follows: Torah Portland Cement Co., 1.4 million tons; Helwân Portland Cement Co., 1.4 million tons; Alexandria Portland Cement Co., 500,000 tons; and National Cement Co. at Assiut, 700,000 tons. To meet a projected local cement demand of 10 million tons, plans were made for the construction of new cement plants and the expansion of existing facilities. New plants in Torah, Alexandria, Suez, Assiut, and Naj Hammādī would add 4 million tons per year to production capacity. Expansion of the four existing plants would add another 2.5 million tons to annual capacity.

Fertilizer Materials.—Egypt's production capacity for nitrogenous and phosphatic fertilizer was estimated at 1.8 million tons per year. Projected increases in capacity were expected to make Egypt self-sufficient in fertilizer production by 1979. In 1976, Cremer and Warner (United Kingdom) was contracted to act as consultant on Egypt's fertilizer projects in conjunction with the Egyptian General Organization for Chemical Industries.

Construction continued in 1976 on the Ṭalkhā and Abū Qīr ammonia-urea projects. The Ṭalkhā plant, which will use natural gas feedstock from the Abu Madi Field, was scheduled for completion in 1978. Constructed by Foster Wheeler Italiana, the plant was to produce 1,200 tons of ammonia and 1,700 tons of urea per day. The Abū Qīr project, to be constructed by Friedrich Uhde GmbH of West Germany, was also to be completed in 1978. Using natural gas from the Abū Qīr Field as feedstock, the plant was to produce 1,200 tons per day of ammonia and urea.

Cremer and Warner was to carry out preliminary studies for the Abu Zaabal triple-superphosphate complex, which was to be partially financed by the United Kingdom. The study was to include an assessment of phosphate from the West Sabaya mine and necessary beneficiation facilities. The complex was scheduled to come onstream in 1979 with a capacity of 170,000 tons per year.

Egypt planned a joint venture with Iran for the construction of a fertilizer complex at Shuqeir on the Red Sea. Projected output of the $400 million complex was 1,200 tons per day of ammonia and phosphoric acid.

Phosphates.—Phosphate production declined from 1.4 million tons in 1968 to approximately 400,000 tons in 1976 owing to the depletion of older mines at Koseir and Safaga. The 1976–80 5-year plan predicted a great increase in production through the exploitation of deposits at Abu Tartûr, Hamrawein, and El Mahâmid. Egypt's three main areas of phosphate deposition were as follows:

1. Red Sea Coast—The Red Sea area of the Eastern Desert has constituted the nucleus of phosphate mining activity with more than 15 mines at two principal locations, Safaga and Koseir. Most of these mines were expected to be depleted by 1980. However, a new phosphate-extraction facility was to come onstream at Hamrawein and produce 600,000 tons of phosphate rock per year.

2. Nile Valley—Smaller phosphate deposits extend along both sides of the Nile Valley between Isnā and Idfū, north of Aswān. Major mines included Abu Sapona, Mahamid, Owayneya, and Naṣr in the Sabaya and Gebel Abou Had areas. El Nasr Phosphate Co. completed feasibility studies on increasing production at the Mahamid mine to 450,000 tons, including 200,000 tons for export.

3. Western Desert—The most promising deposits in the Western Desert were those located at the Abu Tartûr plateau. These deposits were to be the subject of a feasibility study by Sofre-mines of France and Alusuisse of Switzerland. Discovered in 1959, the Abu Tartûr phosphate deposits were estimated to contain reserves of 1 billion tons with an average P_2O_5 content of 25.6%. The projected mine there was expected to produce 10 million tons of ore per year to be processed into 7 million tons of phosphate concentrate. Negative aspects of the deposits included the depth of overburden (170 to 288 meters), the low grade of the deposits, and the remoteness of the location. Infrastructure requirements were estimated to cost $800 million which included a city of 30,000 inhabitants, a 520-kilometer railroad, a 250-kilometer powerline, and a new port.

Gypsum.—The Ras Matarma and Ras Mallap mines, situated in Sinai territory occupied by Israel following the 1967 Arab-Israeli war, were recovered and brought into production in 1976. Reserves were estimated at 2 million tons at Ras Mallap and 15 million tons at Ras Matarma. Gypsum production was used in local cement industries and exported to Japan and Sri Lanka.

MINERAL FUELS

Natural Gas.—Egypt's natural gas reserves were estimated at 5 trillion cubic feet and were concentrated in four major fields. The Abu Madi, Abū Qīr, and Abu al-Gharādiq Fields were in various stages of development; there were no immediate plans to utilize gas associated with oil in the El Morgan Field in the Gulf of Suez.

The Abu Madi Field, situated in the Nile Delta northwest of Port Said, was operated by Delta Petroleum Co., a joint venture of Egyptian General Petroleum Corporation (EGPC) and the Italian firm Ente Nazionale Idrocarburi (ENI). The Field started production in 1974 and was expected to ultimately produce 290 million cubic feet per day of gas, which would be distributed to local industry in the Cairo area, including the Ṭalkhā fertilizer plant, an electric power station, and the Misr spinning and weaving complex.

Reserves were estimated at 1.4 trillion cubic feet.

The Abū Qīr Field, located offshore Alexandria, was operated by Western Desert Operating Petroleum Company (WEPCO), a joint venture of EGPC and Phillips Petroleum Company. In 1976, Combustion Engineering Inc. (United States) was awarded two contracts, totaling $5.3 million, to design and construct a natural gas processing system for the Field. Production, which was to supply a planned sponge iron plant, fertilizer plant, and petrochemical complex in Alexandria, was projected at 124 million cubic feet of gas and 6,000 barrels of condensate per day. Gas reserves were estimated at 1 trillion cubic feet.

The Abu al-Gharādiq Field, situated in the Western Desert, was operated by Faiyum Petroleum Company (FAPCO), a joint venture of EGPC and Amoco Egypt Oil Co., a subsidiary of Standard Oil Co. of Indiana. The Field was to produce 160 million cubic feet of gas per day, which would feed the Helwân iron and steel complex by way of a 300-kilometer pipeline. Reserves were estimated at 2.2 trillion cubic feet.

Petroleum.— *Production.*—Egypt did not become a significant petroleum producer until 1969, and began exporting crude oil in modest amounts in 1974. Total output in 1976 averaged 329,000 barrels per day, including production from the Sinai oilfields which were recovered from Israel in late 1975. This represented an increase of 43% over the 1975 production rate of 230,000 barrels per day. Targeted output of 1 million barrels per day by 1980 was expected to yield annual revenues of $1.4 billion. In 1976, a law was drafted which would set up an Egyptian General Petroleum Authority (EGPA) to replace EGPC and be responsible for oil exploration and development and for oil products distribution.

Approximately 58% (192,000 barrels per day) of Egypt's petroleum output was produced by Gulf of Suez Petroleum Company (GUPCO), which discovered and operated three offshore fields in the Gulf of Suez. GUPCO was a joint venture of EGPC and Amoco. Egypt's largest field, El Morgan, at one time produced at a rate of 350,000 barrels per day, but in 1976, output dropped to 98,000 barrels per day from 42 wells. A $40 million water-injection program was expected to result in the eventual recovery of 1,100 million barrels of crude. The July Field, 19 kilometers northwest of El Morgan, started production in 1974 at the rate of 32,000 barrels per day. Production was expected to reach 100,000 barrels per day when the Field was fully defined. GUPCO's latest field to come onstream was Ramadan, 11 kilometers northwest of El Morgan, which increased output to 40,000 barrels per day in 1976.

GUPCO planned to start commercial production from two other recent discoveries in the Gulf of Suez. Amoco and EGPC were to form a new company, Rudeis Oil Co. (RUDOCO), for the exploitation of a strike made 9 kilometers west of the July Field in the South Gharib concession area. Tests yielded a flow of 2,660 barrels per day, and a second well was planned as part of the initial development program. Production was to begin in 1977 from a second discovery, situated 32 kilometers southeast of El Morgan, which tested at a rate of 3,700 barrels per day. Plans included the construction of six wells from a single platform and a 43-kilometer, 20-inch pipeline to the expanded onshore reception facilities at Ras Shukheir.

FAPCO operated the Abu al-Gharādiq Field in the Western Desert. Production started in 1973 at the rate of 10,500 barrels per day, but dropped to 5,000 barrels per day in 1976. The gas-condensate field was linked by pipeline to the export terminal on the Mediterranean operated by WEPCO.

Nile Valley Petroleum Co. (NIPCO), the third Amoco/EGPC company, operated the al-Razzaq Field northwest of Abu al-Gharādiq. Output averaged 14,000 barrels per year in 1976, but the Field was believed capable of producing 40,000 barrels per day when completely developed.

The two other producing fields in the Western Desert, Alamein and Yidma, were operated by WEPCO. Production at Alamein reached a peak of more than 40,000 barrels per day, but declined to approximately 9,000 barrels per day in 1976. The Yidma Field, discovered in 1971 southwest of Alamein, averaged 5,000 barrels per day in 1976. WEPCO's two other oil discoveries, Meleiha and Um-

baraka, were not yet brought onstream, but development drilling was underway at Umbaraka. In 1972, Phillips assigned 30% of its interest in WEPCO's undeveloped concessions to Hispanoil, a Spanish State firm.

Seven smaller fields in the Eastern Desert were operated by The General Petroleum Company (GPC), wholly owned by the Egyptian Government. Combined output of the Ghârib, Umm-el-Yusr, Bakr, Amir, Karim, Shukheir, and Umm-el-Ayoun Fields was approximately 30,000 barrels per day.

Two groups of oilfields on the Sinai Peninsula which were returned to Egypt in 1975 after 8 years of Israeli occupation produced a combined total of about 65,000 barrels per day in 1976. In an effort to raise production to 100,000 barrels per day, the Government allocated nearly $32 million for the maintenance and repair of oil installations, including pumping stations and loading terminals. Cie. Orientale des Pétroles d'Egypte (COPE), a joint venture of EGPC and ENI, operated the main Sinai fields—Belayim, Abu Rudeis, Sidri, Feiran, and Ekma. Three smaller fields—Ras Sudr, Asl, and Matarma—were operated by GPC, approximately 40 kilometers south of Suez.

Exploration.—Egypt's massive petroleum exploration campaign continued in 1976, with more than 30 onshore and offshore concessions granted to about 24 foreign oil companies (see table 5). The production-sharing contracts provided for the companies to finance all exploration and development costs and spend a given amount on exploration over a period of up to 12 years. In the case of a commercial discovery, a joint company with a contractual lifespan of up to 30 years would be formed with EGPC. The foreign company would recover its expenses from an initial allocation of 40% of production; remaining output would be shared in various proportions with EGPC. It was anticipated that nearly $750 million would be spent on petroleum exploration in Egypt over the next 5 years.

Six general areas were opened for exploration:

1. Gulf of Suez—The Gulf of Suez Basin covers an area of approximately 20,000 square kilometers from Suez to Hurghada. Amoco was the main producer in the Gulf and planned startup of two additional fields in 1977. Transworld Petroleum, Inc. (United States), the first company to conclude a production-sharing agreement with Egypt, completed seismic work in its tract southwest of El Morgan Field and scheduled drilling of an exploratory well for 1977. Deminex (West Germany) drilled a well 12 kilometers north of Ras Shukheir and west of El Morgan. The well tested 37° API gravity low-sulfur crude at a rate of 3,700 barrels per day from two structures at depths of 8,000 and 12,000 feet. Deminex planned further drilling to determine the commercial feasibility of the discovery. A dispute between Egypt and Israel regarding sovereignty over the eastern half of the Gulf of Suez remained unresolved at yearend.

2. Red Sea—No oil discoveries have yet been made in this 25,000-square-kilometer area extending from Hurghada to the Egyptian-Sudanese border. Exxon Corp. (United States), which renewed its exploration rights in Egypt after a 25-year hiatus, held options to drill in deep or shallow water, with its share of production dependent on water depth. Exxon was in the process of drilling its first exploratory well, which was expected to reach a depth of 9,000 feet.

3. Western Desert—Continental Oil Company (Conoco) was the latest company to acquire a concession in this area which stretches south from the Mediterranean Coast between the Libyan border and the Nile Delta and totals about 400,000 square kilometers, including the offshore. In 1976, Conoco was granted prospecting rights to about 300,000 square kilometers in the southern part of the Desert. The agreement provided for an exploration period of 12 years with an exploration commitment of $30 million and a production period of 30 years.

In other leasing action, British Petroleum Company Ltd. (BP) acquired a one-half share in the 4,000-square-kilometer area held by Petroswede Oljeprospektering AB (Sweden) in the Wadi Natrum. Petrobrás Internacional S.A. (BRASPETRO) (Brazil) was reported to have struck oil in an area near the Sakkara Pyramid.

4. Nile Delta—The Nile Delta, an area covering 36,000 square kilometers including the offshore, has yielded two gasfields but little oil. In 1976, a Conoco joint

Table 4.—Egypt: Oilfields, 1976

Company and ownership	Oilfield	Location	Discovery date	Date of first production	Average rate of production (barrels per day)
GUPCO (Amoco and EGPC)	El Morgan	Gulf of Suez	1965	1967	98,000
	July	----do	1973	1974	54,000
	Ramadan	----do	1974	1975	40,000
WEPCO (Phillips and EGPC)	Alamein	Western Desert	1966	1968	9,000
	Yidma	----do	1971	1972	5,000
FAPCO (Amoco and EGPC)	Abu al-Gharādiq	----do	1969	1973	5,000
NIPCO (Amoco and EGPC)	al-Razzaq	----do	1972	1972	14,000
GPC	Ghârib	Eastern Desert	1938	1950	9,000
	Bakr	----do	1958	1960	9,000
	Karim	----do	1958	1960	800
	Amir	----do	1965	1965	2,000
	Shukheir	----do	1966	1967	600
	Umm-el-Ayoun	----do	1968	1969	2,000
	Umm-el-Yusr	----do	1968	1970	6,000
	Ras Sudr	Sinai	1946	1949	1,500
	Asl	----do	1947	1949	1,500
	Matarma	----do	1948	1954	600
COPE (ENI and EGPC)	Ekma	----do	1949	1953	500
	Feiran	----do	1949	1952	1,500
	Belayim	----do	1954	1955	29,000
	Abu Rudeis	----do	1957	1958	30,000
	Sidri	----do	1957	1957	1,000

venture tested the Qantara No. 1 well at 2,635 barrels per day of oil and 13 million cubic feet per day of gas at a depth of 10,200 feet. The discovery, situated in the northern delta 6 kilometers west of the Suez Canal, was to be further evaluated by the members of the joint venture, International Egyptian Oil Co. (I.E.O.C.) (50%), Conoco (25%), and Marathon Petroleum Egypt, Ltd. (25%).

5. Nile Basin—Few discoveries were made in the Nile Basin, a 100,000-square-kilometer area bounded to the west by the Kharga-Wadi El Rayan uplift and to the east by the Red Sea Hills. The Santa Fe International Corp. (United States) oil and gas concession was completing its first exploratory well at a depth of 12,500 feet at yearend. Membership in the venture was changed to Santa Fe 35%, Central Energy Development Co. (Japan) 25%, Bow Valley Industries (Canada) 20%, and Cities Service Oil Company 20%.

6. North Sinai—The northern portion of the Sinai Peninsula down to the latitude of Suez and including the Mediterranean offshore area encompassed a total area of 40,000 square kilometers. In November 1976, Egypt concluded agreements with Conoco, Gulf Oil Company, and a Total/AGIP S.p.A. joint venture for exploration in this territory, which was recovered from Israel after the 1973 Arab-Israeli war. Formal conclusion of the three agreements, covering seven blocks with a total area of 8,400 square kilometers, awaited a United Nations decision regarding exploration rights in the Egyptian-Israeli buffer zone. Egypt was negotiating with other companies regarding exploration in five other blocks in North Sinai totaling 6,000 square kilometers.

Refining.—Egypt's petroleum refining capacity was estimated at 255,000 barrels per day (13 million tons per year) in 1976. Total throughput was approximately 200,000 barrels per day, compared with 150,000 barrels per day in 1975. Egypt continued to expand its refining capacity by repairing and recommissioning the two Suez refineries damaged in the 1967 war and expanding other facilities.

GUPCO operated three refineries: The Suez refinery, where capacity was restored to 37,000 barrels per day after the war; the Musturud refinery near Cairo, which was expanded to refine 67,000 barrels per day; and the Tanta refinery in the Nile Delta with a 37,000-barrel-per-day capacity. Naşr Petroleum Co. operated two refineries, one in Suez where capacity was restored to 32,000 barrels per day and one in Amreya which came onstream in 1972 with a capacity of 23,000 barrels per day, later expanded to 32,000 barrels per day. Alexandria Petroleum Co. operated a single refinery at Alexandria with a 50,000-barrel-per-day capacity. Plans for the construction of a $400 million, 250,000-barrel-per-day export refinery in the Alexandria free zone were under consideration.

In 1976, EGPC contracted Montedison S.p.A. (Italy) for the construction of a $400 million petrochemical complex in Alexandria. The proposed complex, in which EGPC would have a 75% interest, was to produce 100,000 tons of low-density polyethylene, 30,000 tons of high-density polyethylene, and 60,000 tons of polyvinyl chloride per year.

Pipelines.—Experimental testing of the $500 million SUMED oil pipeline began in mid-December 1976. The SUMED system consisted of two 320-kilometer, 42-inch pipelines with a combined capacity of 1.6 million barrels per day (80 million tons per year). The pipeline, which was to supply Mediterranean ports with Middle East crude oil, was operated by Arab Petroleum Pipeline Co., owned by Egypt (50%), Saudi Arabia (15%), Kuwait (15%), the United Arab Emirates (15%), and Qatar (5%). Construction was by an Italian consortium sponsored by Montaggi Materiali Tubolari S.p.A. (Montubi) and including SAIPEM S.p.A. and SNAM Progetti, S.p.A., subsidiaries of ENI. Bechtel Corp. (United States) acted as technical adviser. Two terminals, Ain Sukhna on the Gulf of Suez and Sidi Kreir on the Mediterranean, were being expanded to accommodate tankers of up to 250,000 deadweight tons.

The basic transit fee for SUMED was set at $1.60 per ton of oil in addition to a 25¢-per-ton charge for deballasting water. Mobil Oil Corp. signed a 10-year agreement (to begin in 1977) that provides for the throughput of 5 million tons of oil per year during the first 5 years and 10 million tons per year during the second 5 years. SUMED also had letters of intent from Exxon for 5.0 million to 7.5 million tons per year from 1977 to 1980, and Petrofina, S.A., of Belgium for 3 million to 5 million tons per year.

Table 5.—Exploration agreements finalized between EGPC and foreign companies in 1976

Location	Foreign company	Date of agreement	Acreage (square kilometers)	Bonuses (millions)		Exploration commitments	Production sharing [1] (percent)
				Signature	Production		
Gulf of Suez	Amoco	July 1974	100 (South Ghârib)	$3	$7	$2,000,000 for 2 years	80–20
	Do	December 1974	600 (South Belayim)	8.5	12	$20,500,000 for 7.5 years	85–15
	Do	----do	1,350 (South Gharah)	12	12	$29,000,000 for 7.5 years	85–15
	Deminex	February 1974	2,000	3	--	$22,000,000 for 8 years	80–20
	EPEDECO [2]	May 1975	527	3	9	$21,000,000 for 6 years	87–13
	Mobil	July 1974	2,250 (Hurghada)	6	12	$21,500,000 for 8 years	80–20
	Shell/BP/Deminex	December 1974	1,350 (North Belayim)	7.5	12	$26,000,000 for 7 years	82.5–17.5
	Transworld	August 1973	100	--	--	$5,600,000 for 4 years	80–20
Red Sea	Exxon	December 1974	12,000	4.5	6	$48,000,000 for 12 years	70/80–30/20
	Phillips/Hispanoil	----do	12,000 (Quseir)	1	6	$45,000,000 for 8 years	80–20
	Union Oil	July 1974	10,000	5.5	10	$30,000,000 for 7 years	85–15
Western Desert	Atlantic Richfield	December 1974	3,320 (Marsá Matrūh)	2	6	$11,000,000 for 8 years	85–15
	BRASPETRO	August 1973	18,000 (Western and Eastern Deserts and Nile Valley)	--	--	$14,400,000 for 8 years	50–50
	Chevron	December 1974	6,900 (Qattara)	2	14	$17,000,000 for 7 years	80–20
	Conoco	May 1976	300,000	--	6	$30,000,000 for 12 years	80–20
	Mobil	December 1974	5,300 (Sallum)	--	9	$8,250,000 for 8 years	80–20
	Petroswede/BP	----do	4,000 (Natrum)	.5	6	$10,500,000 for 8 years	80–20
	Pexamin Pacific/ LVO Corp.	May 1974	3,000 (Natrum)	.5	--	$9,000,000 for 8 years	75–25
	Shell	December 1974	8,500 (al-Daba)	3	8	$39,500,000 for 8 years	80–20
	Do	----do	6,400 (Sīdī Barrānī)	2.5	8	$25,500,000 for 8 years	80–20
Nile Delta	Conoco	May 1974	8,500	--	6	$23,000,000 for 10 years	75–25 (oil) 67.5–32.5 (gas)
	Conoco/I.E.O.C./ Marathon.	March 1974	13,000	--	--	$20,000,000 for 8 years	--
	Elf-Erap	March 1975	2,200	2.5	--	$37,500,000	70/85–30/15
	Exxon	December 1973	15,000	--	--	$50,000,000 for 12 years	--
	Mobil	----do	6,500	2.5	--	$23,000,000 for 8 years	--
Nile Basin	Santa Fe	December 1974	4,500	1	10	$18,000,000 for 7 years	80–20
	Transworld	March 1974	7,300	--	--	$9,000,000 for 6 years	75–25
North Sinai	Conoco	November 1976	3,600	3	--	$28,500,000	NA
	Gulf	----do	2,400	4	--	$28,500,000	NA
	Total/AGIP	----do	2,400	3	--	$30,000,000	NA

NA Not available.

[1] Percentage of production sharing between EGPC (first figure) and foreign company (second figure), after allocation of 40% of production to cover the latter's costs.

[2] Egyptian Petroleum Development Co.

A new pipeline to supply Cairo and Suez with oil from offshore fields in the Gulf of Suez was to be partially financed by the Kuwait Development Fund and operated by the State-owned Petroleum Pipelines Co. The $70 million pipeline, which was to start 30 kilometers offshore from Ras Shukheir, was to have an initial capacity of 8 million tons per year, expandable to 12 million tons per year.

The Mineral Industry of Finland

By Joseph B. Huvos [1]

A moderate-size producer of mineral commodities, Finland had no domestic energy sources besides some hydroelectric power, fuelwood, and peat. The country's most important mineral products in 1976, with approximate percentages of the world total, were as follows: Vanadium, 6.2%; cobalt metal, 4.7%; refined zinc, 2.2%; chromite, 2.0%; refined nickel, 0.9%; and mine copper, 0.5%. Other commodities of continuing national importance were iron and steel, cement, feldspar, fertilizer materials, talc, and wollastonite.

The country's gross national product (GNP) was $28.8 billion [2] in 1976.[3] Mining and quarrying contributed $111 million or 0.4% of the total; the minerals industry, including processing of minerals into products, contributed an estimated 4%. Employment was about 6,000 in mining and quarrying and an estimated 80,000 for the minerals industry as a whole, including processing.

The country's inflation rate and trade deficit decreased to 15% and $270 million, respectively, while unemployment increased to 4% in 1976.

Significant developments in Finland's mineral industry in 1976 included the commissioning of Outokumpu Oy's stainless steel plant at Tornio on the Gulf of Bothnia and of the company's ore mill at the Pyhälsami, Phyäjärvi mine; Rautaruukki Oy's steelwork expansion at Raahe on the Baltic Sea; and construction of United Paper Mill's peat-fired powerplant at Simpele on Finland's western border. Trial runs started at Rautaruukki Oy's Mustavaara vanadium mine in central Finland. Construction continued on four Government-controlled nuclear powerplants and on Outokumpu's chromium mine at Kemi near Tornio. Decisions were made to terminate nickel ore production at Outokumpu's Vuonos mine near Outokumpu and sulfur production at Kokkola on the Baltic Sea.

PRODUCTION

Volume indices of production for the principal sectors of the mineral industry and the country's industry as a whole are shown in the following tabulation:

Sector	1970=100	
	1975	1976 [p]
Mining and quarrying	97	111
Nonmetallic mineral processing	134	127
Iron and steel	133	138
Nonferrous metals	106	109
Petroleum refining	113	143
Industrial chemicals	159	139
All industry	121	124

[p] Preliminary.

Source: Central Statistical Office of Finland, Helsinki. Bulletin of Statistics, 1977. No. 6, pp. 8–9.

Production of mineral commodities is detailed in table 1.

The following tabulation shows the major producers of commodities.

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values in Finland marks (Fmk) were converted to U.S. dollars at the rate of Fmk3.8504=US$1.00 for 1976 and Fmk3.6867=US$1.00 for 1975.

[3] U.S. Department of Commerce. International Marketing Information Series. Foreign Economic Trends. Finland. American Embassy, Helsinki. May 1977, p. 4.

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Chromite	Outokumpu Oy, mine at Elijärvi-Kemi, Government 51%, National Pension Institute 49%	100
Cobalt ore	Outokumpu Oy, mine at Keretti	100
Copper-nickel ore	Outokumpu Oy, mines at Keretti, Viaalanti, Virtasalmi, Hitura, Kotalahti, and Vuonos and smelter and refinery at Harjavalta	95
Iron ore	Rautaruukki Oy, mines at Rautavaara, Mustavaara, and Otanmäki, Government 98%	100
Iron and steel	Rautaruuki Oy, plant at Raahe, Government	50
Do	Ovako Group, plants at Immatra, Turku, and Lappvik	50
Lead and zinc ore	Outokumpu Oy, mines at Vuonos, Pyhäsalmi, Hammaslahti, and Vihanti	90
Do	Myllykoski Oy, Luikonlahti	10
Petroleum products	Neste Oy, refineries at Porvoo and Naantali, Government 98%	100
Vanadium ore	Rautaruukki Oy, iron mine at Mustavaara, Government	100
Zinc, smelter	Outokumpu Oy, plant at Kokkola	100

Table 1.—Finland: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum, secondary	5,300	5,300	6,100
Cadmium metal, refined	156	217	428
Chromium, chromite:			
Gross weight:			
Concentrate	126,242	131,567	143,302
Foundry sand	28,419	33,026	31,567
Chrome oxide content:			
Concentrate	53,148	52,890	57,894
Foundry sand	13,330	15,291	14,679
Cobalt:			
Mine output, metal content	e 1,300	1,402	1,279
Metal, refined	812	821	892
Copper:			
Mine output, metal content	r 36,151	38,800	38,209
Metal:			
Primary:			
Blister	r 44,061	46,930	51,516
Electrolytic	38,277	35,764	38,142
Secondary (unrefined)	17,014	11,335	9,527
Gold metal, troy ounces	20,737	22,216	26,267
Iron and steel:			
Iron ore:			
Magnetite, concentrate, thousand tons	569	376	599
Pelletized iron oxide (from pyrite), do	236	280	328
Roasted pyrite (purple ore), do	132	138	129
Pig iron, do	1,381	1,368	1,329
Ferrochromium, do	48	40	40
Steel:			
Ingots, do	1,617	1,579	1,614
Castings, do	39	39	30
Semimanufactures (rolled), do	1,124	1,087	1,161
Lead, mine output, metal content, do	1,478	929	1,131
Mercury, 76-pound flasks	183	309	383
Nickel:			
Mine output, metal content	5,762	5,404	6,103
Sulfate, metal content	186	207	190
Metal, electrolytic	6,455	6,544	7,624
Platinum metal, troy ounces	650	600	640
Selenium metal, kilograms	9,690	8,477	9,931
Silver metal, troy ounces	810,712	743,839	773,256
Titanium concentrate, ilmenite, gross weight	152,000	122,600	122,600
Vanadium pentoxide:			
Gross weight	2,647	2,276	2,589
Vanadium content	1,483	1,275	1,450
Zinc:			
Mine output, metal content	r 60,976	54,356	61,143
Metal	91,786	109,885	110,633
Semimanufactures	203	122	105

See footnotes at end of table.

Table 1.—Finland: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS			
Asbestos	5,593	2,788	--
Cement, hydraulic ---thousand tons	2,203	2,063	1,825
Feldspar	63,577	68,577	68,213
Fertilizer materials:			
Natural, phosphatic (apatite) ---thousand tons	--	114	4
Manufactured:			
Nitrogenous ---do---	311	NA	NA
Phosphatic (superphosphate) ---do---	62	NA	NA
Mixed and other ---do---	1,085	NA	NA
Lime ---do---	245	259	250
Pyrite:			
Gross weight ---do---	722	718	674
Sulfur content ---do---	341	329	318
Stone:			
Limestone and dolomite:			
For cement ---do---	3,202	2,861	2,394
For lime ---do---	512	482	462
For sulfite and metallurgical use ---do---	144	128	128
Other ---do---	774	893	1,267
Quartz ---do---	120	105	109
Sulfur, byproduct (recovered):			
Elemental	99,589	84,409	85,733
Gaseous (in SO_2)	246,685	261,624	282,634
Talc	128,269	124,260	148,531
Wollastonite	9,118	13,089	6,165
MINERAL FUELS AND RELATED MATERIALS			
Gas, manufactured ---million cubic feet	r 1,009	959	NA
Peat:			
For fuel use ---thousand tons	116	200	360
For agricultural and other use ---do---	127	165	198
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	11,994	11,837	14,235
Jet fuel ---do---	1,285	1,665	1,554
Kerosine ---do---	--	134	30
Distillate fuel oil ---do---	18,067	18,517	23,990
Residual fuel oil ---do---	25,085	20,833	27,255
Liquefied petroleum gas ---do---	1,098	983	1,007
Other ---do---	3,661	2,726	5,344
Refinery fuel and losses ---do---	5,445	3,402	7,863
Total ---do---	66,635	60,097	81,278

e Estimate. p Preliminary. r Revised. NA Not available.

TRADE

There was no significant change in the pattern of Finland's foreign trade in 1976. The principal mineral commodities exported, going mainly to Western Europe, were iron and steel, cobalt, copper, nickel, vanadium, zinc, asbestos, feldspar, and talc. Mineral commodity imports, of which fuels and power were 60%, were valued at about one-third of all imports. Finland's mineral commodity trade in 1974 and 1975 is shown in tables 2 and 3.

Table 2.—Finland: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys:			
Scrap	34	34	All to West Germany.
Unwrought	903	548	Sweden 533.
Semimanufactures	14,212	13,691	Norway 3,597; Sweden 2,908; Netherlands 1,926; U.S.S.R. 1,682.
Arsenic trioxide, pentoxide, and acids	18	(1)	NA.
Cadmium metal including alloys, all forms	241	189	Sweden 80; United Kingdom 75.
Chromium, chromite	83,942	150,421	Sweden 58,911; United States 54,354.
Cobalt metal, unwrought and semimanufactures	808	810	Canada 290; United States 232; United Kingdom 167.
Copper:			
Ore and concentrate	--	78	All to West Germany.
Metal including alloys:			
Scrap	365	1,930	Sweden 1,753.
Unwrought including matte	12,192	14,457	Belgium-Luxembourg 11,063.
Semimanufactures	14,212	14,762	Sweden 3,905; United Kingdom 3,638; France 2,188.
Gold metal, unworked or partly worked troy ounces	701	7,652	West Germany 7,363.
Iron and steel:			
Ore and concentrate, except roasted pyrite	22	862	Sweden 615; East Germany 247.
Roasted pyrite	11	NA	
Metal:			
Scrap	8,445	5,106	West Germany 2,509; United Kingdom 1,622; Sweden 972.
Pig iron, ferroalloys, spiegeleisen, similar materials	217,979	126,624	Sweden 83,498.
Steel, primary forms	240,409	237,810	Sweden 158,369; West Germany 52,267.
Semimanufactures	210,453	206,862	Sweden 63,554; West Germany 27,756; Norway 22,888.
Lead:			
Ore and concentrate	3,803	NA	
Metal including alloys:			
Scrap	1,140	408	Sweden 177.
Unwrought	195	66	Sweden 63.
Semimanufactures	28	8	Sweden 6; West Germany 2.
Mercury 76-pound flasks	35	116	Sweden 58; United States 29; West Germany 29.
Nickel metal including alloys:			
Unwrought	5,509	5,862	United Kingdom 1,351; Sweden 722; West Germany 718; France 713.
Semimanufactures	--	141	Czechoslovakia 109.
Platinum-group metals including alloys troy ounces	537	1,254	West Germany 1,093.
Silver metal including alloys thousand troy ounces	970	611	West Germany 418; Netherlands 129.
Tin metal including alloys:			
Scrap	--	12	United Kingdom 10.
Unwrought	21	2	All to United Kingdom.
Semimanufactures	5	2	All to Netherlands.
Titanium:			
Ore and concentrate	1	NA	
Oxides	1,814	2,268	NA.
Uranium oxides	2,681	2,407	France 609; Sweden 535; West Germany 408; United Kingdom 330; U.S.S.R. 300.

See footnotes at end of table.

Table 2.—Finland: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Zinc:			
Ore and concentrate	7,091	3,660	Norway 3,638.
Oxide	7	(1)	NA.
Metal:			
Scrap	633	376	West Germany 124; Sweden 83; Pakistan 51; United Kingdom 46; Belgium-Luxembourg 37.
Unwrought	67,017	79,766	United Kingdom 28,175; United States 19,818; Sweden 14,634.
Semimanufactures	2,283	7,820	Czechoslovakia 1,817.
Other:			
Ash and residue containing nonferrous metals	4,777	2,381	Sweden 928; West Germany 588; Italy 329; Denmark 295.
Waste and sweepings of precious metals kilograms	19,071	7,214	Sweden 4,494; Denmark 2,016.
Base metals, n.e.s	25	1	Mainly to Norway.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice	16	(1)	NA.
Grinding and polishing wheels and stones	24	NA	
Asbestos	4,867	3,512	West Germany 1,890.
Borates, crude, natural	438	450	All to Sweden.
Cement	65,857	16,772	Poland 15,082.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Kaolin	4	(1)	NA.
Other	167	304	Sweden 280.
Clay products:			
Refractory	778	346	U.S.S.R. 133; United States 82; United Kingdom 40.
Nonrefractory	2,959	128	U.S.S.R. 55; Norway 51.
Cryolite and chiolite	10	NA	
Diamond, gem, not set or strung carats	1,000	NA	
Diatomite and other infusorial earth	34	10	Mainly to Sweden.
Feldspar	46,369	49,169	United Kingdom 35,333.
Fertilizer materials, manufactured:			
Nitrogenous	22,617	9,038	People's Republic of China 8,992.
Potassic	14,232	29	Mainly to Sweden.
Other including mixed	25,539	44	Norway 20; Sweden 6; Austria 6; Iran 6.
Graphite	(1)	NA	
Lime	694	900	All to U.S.S.R.
Magnesite	16	NA	
Mica, all forms	30	NA	
Precious and semiprecious stones, except diamond:			
Natural kilograms	14	38	Sweden 12; East Germany 10; United States 7.
Manufactured do	(1)	(1)	NA.
Salt (excluding brine)	7	(1)	NA.
Sodium and potassium compounds, n.e.s., caustic soda	1,961	169	Poland 168.
Stone, sand and gravel:			
Dimension stone	39,914	44,584	Italy 15,673; France 8,650; East Germany 7,108; Spain 4,866.
Other stone:			
Dolomite	804	12	All to Sweden.
Limestone	17,909	15,831	Sweden 14,634.
Quartz and quartzite	564	480	Sweden 464.
Crushed and broken stone and gravel, n.e.s	55,605	20,316	U.S.S.R. 20,253.
Sand excluding metal bearing	929	673	Sweden 537; East Germany 85.
Sulfur:			
Elemental, all forms	20,204	1,423	NA.
Sulfuric acid	57,202	80,690	Sweden 66,524; Canada 14,166.
Talc and steatite	1,855	4,750	U.S.S.R. 3,518; Poland 587.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet	10	NA	
Other	72,753	3,312	East Germany 1,148; Spain 756; Denmark 710.
Slag, dross, and similar waste, not metal bearing:			
From manufacture of iron and steel	3,811	2,345	All to West Germany.

See footnotes at end of table.

Table 2.—Finland: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Other nonmetals, n.e.s.—Continued			
Slag, dross, and similar waste, not metal bearing—Continued			
Slag and ash, n.e.s	491	NA	
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	6,594	3,691	Sweden 2,424; U.S.S.R. 414; Norway 394.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	4	829	U.S.S.R. 827.
Carbon black	2	NA	
Coal, all grades, including briquets	40	NA	
Coke and semicoke	9,269	NA	
Hydrogen, helium, rare gases	(1)	NA	
Peat including peat briquets and litter	16,796	8,657	Netherlands 2,062; Sweden 1,664.
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	2,213	1,080	Sweden 927; United States 153.
Distillate fuel oil—do	9	(1)	NA.
Lubricants—do	33	60	U.S.S.R. 47; Sweden 7.
Other:			
Liquefied petroleum gas—do	12	NA	
Mineral jelly and wax—do	7	24	Mainly to West Germany.
Nonlubricating oils, n.e.s—do	1	NA	
Bitumen and bituminous mixtures, n.e.s—do	4	55	All to U.S.S.R.
Unspecified—do	(1)	(1)	NA.
Mineral tar and other coal–, petroleum–, or gas–derived crude chemicals	NA	NA	

NA Not available.
[1] Less than ½ unit.

Table 3.—Finland: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Ore and concentrate	2,000	8,759	Belgium-Luxembourg 8,335.
Oxide and hydroxide	21,683	24,741	Hungary 12,509; West Germany 5,163; United Kingdom 2,580.
Metal including alloys:			
Unwrought	25,619	19,168	U.S.S.R. 9,450; Hungary 3,521; Ghana 2,501; Norway 2,495.
Semimanufactures	31,299	20,842	Sweden 4,743; Norway 3,693; West Germany 2,221.
Antimony metal including alloys, all forms	77	8	Sweden 7; West Germany 1.
Arsenic trioxide, pentoxide, and acids	723	719	Sweden 718.
Cadmium metal including alloys, all forms	(1)	1	Mainly from West Germany.
Chromium:			
Chromite	170	NA	
Oxide and hydroxide	645	1,869	Sweden 1,355; East Germany 183.
Cobalt:			
Oxide and hydroxide	1	19	Sweden 18.
Metal including alloys, all forms	21	5	Sweden 2; Belgium-Luxembourg 2; West Germany 1.
Copper:			
Ore and concentrate	36,265	2,878	Poland 1,620; Norway 800; United States 362.
Copper sulfate	3,853	2,906	U.S.S.R. 2,171; Netherlands 342.
Metal including alloys:			
Scrap	22	121	United States 89.
Unwrought	15,748	14,643	U.S.S.R. 5,150; Sweden 3,601; Zambia 1,650; Chile 1,478.
Semimanufactures	10,939	9,919	Sweden 4,477; United Kingdom 3,072; West Germany 921.
Gold metal, unworked or partly worked troy ounces	87,649	57,485	West Germany 39,544; United Kingdom 11,896.
Iron and steel:			
Ore and concentrate, except roasted pyrite	1,133,316	1,206,000	Sweden 750,018; Norway 250,629.
Metal:			
Scrap	84,795	94,939	U.S.S.R. 74,477; United States 9,254.
Pig iron including cast iron	40,006	52,187	Sweden 37,315; West Germany 14,502.
Sponge iron, powder and shot	4,995	4,983	Sweden 2,763; United Kingdom 968; Spain 797.
Ferroalloys	27,601	24,694	Norway 14,576; U.S.S.R. 7,731.
Steel, primary forms	6,725	24,018	Sweden 20,568; United Kingdom 2,110.
Semimanufactures:			
Bars, rods, angles, shapes, sections	369,137	290,261	West Germany 80,425; Sweden 60,770; Norway 30,037.
Universals, plates, sheets	220,403	200,687	West Germany 67,628; Sweden 42,342.
Hoop and strip	64,053	38,153	West Germany 17,134; Sweden 8,907; United Kingdom 4,772; Belgium-Luxembourg 3,932.
Rails and accessories	4,154	17,338	France 9,441; Belgium-Luxembourg 3,946.
Wire	19,384	18,435	United Kingdom 5,842; Sweden 3,232; France 2,166; Australia 2,030; West Germany 1,966.
Tubes, pipes, fittings	153,689	127,438	West Germany 49,068; United Kingdom 19,590; Sweden 13,644.
Castings and forgings, rough	1,977	1,341	Sweden 387; Switzerland 284; West Germany 250.
Lead:			
Ore and concentrate	112,326	NA	
Oxides	409	281	West Germany 139; Belgium-Luxembourg 76; East Germany 60.
Metal including alloys:			
Unwrought	13,548	13,982	U.S.S.R. 8,268; Sweden 3,953.
Semimanufactures	1,100	975	West Germany 623; Denmark 239.
Magnesium metal including alloys, all forms	81	70	United Kingdom 21; Switzerland 20; Sweden 10; Netherlands 10.

See footnotes at end of table.

Table 3.—Finland: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Manganese:			
Ore and concentrate	29,652	4	Sweden 3; Norway 1.
Oxides	934	1,652	People's Republic of China 863; Republic of South Africa 282; Netherlands 250.
Mercury ----------76-pound flasks--	670	1,392	Mexico 696; Yugoslavia 406.
Molybdenum metal including alloys, all forms	4	3	Austria 2.
Nickel:			
Ore and concentrate	12,608	10,276	Norway 10,064.
Metal including alloys:			
Scrap	34	86	Sweden 74; United Kingdom 12.
Unwrought	1,528	297	United Kingdom 77; U.S.S.R. 54.
Semimanufactures	160	116	West Germany 45; United Kingdom 28.
Phosphorus	10	5	All from Sweden.
Platinum-group metals thousand troy ounces--	8	7	U.S.S.R. 4; Sweden 3.
Silver metal including alloys ------do----	3,464	2,266	West Germany 868; United Kingdom 675; U.S.S.R. 643.
Silicon	356	367	Sweden 361.
Tin:			
Oxides	8	3	United Kingdom 2; West Germany 1.
Metal including alloys:			
Unwrought	386	172	United Kingdom 41; Sweden 40; Netherlands 33; People's Republic of China 25.
Semimanufactures	143	103	United Kingdom 59.
Titanium:			
Ore and concentrate	17,561	15,282	Norway 14,182.
Oxides	27	124	Norway 69; West Germany 31; Sweden 19.
Tungsten:			
Ore and concentrate	2	2	All from Sweden.
Metal including alloys, all forms	21	21	United Kingdom 9; United States 5.
Zinc:			
Ore and concentrate	112,326	121,358	Denmark 72,105; Peru 47,126.
Oxides	550	510	United Kingdom 280; United States 73; Netherlands 65.
Metal including alloys:			
Scrap	526	31	Denmark 21; Belgium-Luxembourg 10.
Blue powder	NA	375	Norway 151; Belgium-Luxembourg 99.
Unwrought	1,096	2,488	Republic of Korea 1,398; Norway 416; Poland 351.
Semimanufactures	877	527	Norway 181; United Kingdom 133; Belgium-Luxembourg 123.
Other:			
Ore and concentrate, n.e.s	20,956	18,626	Netherland 10,322; Sweden 8,296.
Ash and residue containing nonferrous metals	243	2,460	United States 2,091.
Metal including alloys, all forms:			
Metalloids, n.e.s	5	10	Austria 6; Brazil 2; West Germany 1; United States 1.
Pyrophoric alloys	2	1	Mainly from Austria.
Base metals, n.e.s	522	198	Sweden 67; Republic of South Africa 60; United Kingdom 34; West Germany 21.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	183	109	Italy 41; West Germany 29; Netherlands 22; Sweden 11.
Dust and powder of precious and semiprecious stones, except diamond kilograms--	4	1	Mainly from Netherlands.
Grinding and polishing wheels and stones	2,491	2,472	United States 475; Austria 406; Sweden 359; United Kingdom 335; West Germany 266.
Asbestos	6,172	10,132	Republic of South Africa 2,975; Canada 1,746.

See footnotes at end of table.

Table 3.—Finland: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Barite and witherite	2,688	2,038	West Germany 1,385.
Borates, crude, natural	11,350	12,086	United States 7,861; Turkey 3,215.
Cement	84,882	28,211	U.S.S.R. 13,766; Sweden 9,085.
Chalk	10,445	6,546	Denmark 2,021; France 1,333; Sweden 849.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Kaolin	379,203	221,628	United Kingdom 213,614.
Other	42,491	38,695	United Kingdom 11,595; Czechoslovakia 7,010; U.S.S.R. 6,533.
Products:			
Refractory (including nonclay bricks)	67,905	66,963	U.S.S.R. 27,551; United Kingdom 11,374; West Germany 10,734; Sweden 6,675.
Nonrefractory	5,319	9,759	U.S.S.R. 8,174; Sweden 1,160.
Cryolite and chiolite	79	70	Mainly from Denmark.
Diamond, industrial ——carats	25,000	25,000	Netherlands 15,000; Belgium-Luxembourg 5,000.
Diatomite	1,361	1,115	United States 684; Iceland 238.
Feldspar, leucite, nepheline syenite	37	47	Sweden 22; Norway 20.
Fertilizer materials:			
Crude, phosphatic	570,009	623,003	U.S.S.R. 376,480; Morocco 161,983; Senegal 84,529.
Manufactured:			
Nitrogenous	27,215	18,621	Norway 7,936; Sweden 4,205; Netherlands 3,640.
Phosphatic	90	690	Ireland 600.
Potassic	286,396	305,908	West Germany 111,222; U.S.S.R. 95,772; East Germany 76,634.
Other including mixed	4,444	1,396	Norway 835; Belgium-Luxembourg 410.
Ammonia	86,857	46,069	U.S.S.R. 22,869; Netherlands 12,152; France 7,205.
Fluorspar	5,191	4,385	West Germany 2,145; Spain 1,129; East Germany 491; People's Republic of China 450.
Graphite, natural	824	516	West Germany 145; Poland 125; United Kingdom 96; Norway 85.
Gypsum and plasters	184,608	151,672	U.S.S.R. 74,090; Poland 59,333; Spain 15,590.
Lime	1,462	20	Sweden 6; United Kingdom 6; Denmark 4; West Germany 3.
Magnesite	2,527	1,958	Austria 1,590.
Mica, all forms	303	255	United Kingdom 143; Norway 49; West Germany 39.
Pigments, mineral:			
Natural, crude	149	95	Cyprus 37; Hungary 30; United Kingdom 16.
Iron oxides, processed	3,350	2,507	West Germany 2,264.
Precious and semiprecious stones except diamond:			
Natural ——kilograms	3,444	3,113	Brazil 1,697; Republic of South Africa 518; West Germany 475.
Manufactured ——do	146	159	Switzerland 94; West Germany 39.
Salt (excluding brine)	648,276	513,996	Netherlands 274,288; East Germany 67,633; U.S.S.R. 59,426.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	1,975	17,977	Sweden 15,450; Belgium-Luxembourg 2,497.
Caustic potash	431	474	West Germany 141; France 138; East Germany 130.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	646	287	Italy 173; Norway 79.
Worked	216	295	Sweden 115; Spain 75; Italy 48; United Kingdom 37.
Dolomite, chiefly refractory grade	10,817	7,362	Belgium-Luxembourg 5,961; Sweden 732.
Gravel and crushed rock	107,442	12,870	Sweden 11,155.
Limestone, except dimension	421,711	404,151	Sweden 399,583.
Quartz and quartzite	418	567	Norway 206; West Germany 161; Portugal 124.

See footnotes at end of table.

Table 3.—Finland: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Stone, sand and gravel—Continued			
Sand excluding metal bearing	126,734	86,120	Belgium-Luxembourg 65,693; Denmark 11,723.
Sulfur:			
Elemental	36,536	27,413	France 16,002; Poland 11,026.
Sulfuric acid	85	192	Norway 112; West Germany 36.
Talc and steatite	1,685	822	Belgium-Luxembourg 407; Austria 100; Norway 91.
Other nonmetals, n.e.s.:			
Crude	1,766	1,075	West Germany 351; Republic of South Africa 320; Denmark 187.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture	--	23,680	Switzerland 14,962; Sweden 8,578.
Slag and ash, n.e.s	20	115	All from West Germany.
Oxides and hydroxides of magnesium, strontium, and barium	13,809	14,797	U.S.S.R. 6,670; Republic of Korea 3,351; People's Republic of China 2,058.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	4,893	4,976	Denmark 2,369; West Germany 513; Sweden 476.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	399	263	Trinidad and Tobago 238.
Carbon black and gas carbon	7,029	6,804	West Germany 2,846; United Kingdom 1,891; Netherlands 1,298.
Coal, all grades, including briquets thousand tons	3,940	4,737	Poland 3,380; U.S.S.R. 1,165.
Coke and semicoke do	979	889	U.S.S.R. 651; United Kingdom 125.
Gas, natural do	NA	426	Mainly from U.S.S.R.
Hydrogen, helium, rare gases	170	85	Netherlands 46; Sweden 18; Denmark 15.
Peat including peat briquets and litter	554	1,907	U.S.S.R. 1,846.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	69,558	67,354	U.S.S.R. 41,048; Iran 12,124; Saudi Arabia 10,213.
Refinery products:			
Gasoline do	749	366	U.S.S.R. 204; Netherlands 51.
Jet fuel do	34	NA	
Kerosine do	69	186	United Kingdom 85; U.S.S.R. 47; West Germany 31.
Distillate fuel oil do	14,463	15	All from U.S.S.R.
Residual fuel oil do	14,112	7,373	U.S.S.R. 6,587.
Lubricants do	757	753	United Kingdom 220; U.S.S.R. 153; Netherlands 127; Sweden 100.
Other:			
Liquefied petroleum gas do	4,828	3,853	All from U.S.S.R.
Naphtha do	704	(1)	NA.
White spirit do	51	186	United Kingdom 85; U.S.S.R. 47; West Germany 31.
Mineral jelly and wax do	135	165	U.S.S.R. 71; West Germany 55; People's Republic of China 16.
Nonlubricating oils, n.e.s do	18	NA	
Bitumen and bituminous mixtures, n.e.s do	381	394	Netherlands 188; Denmark 121; Sweden 73.
Pitch, pitch coke, petroleum coke do	11	11	West Germany 6.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	12,707	20,400	U.S.S.R. 9,815; Poland 9,184.

NA Not available.
[1] Less than ½ unit.

COMMODITY REVIEW

METALS

In 1976, Finland operated 13 metal mines, including 9 that were controlled by Outokumpu Oy, 3 by Rautaruukki Oy, and 1 by Myllykoski Oy. Products extracted from ores mined included cadmium, copper, cobalt, iron, lead, nickel, precious metals, selenium, sulfur, and vanadium. Government-controlled Outokumpu Oy's production of base metal concentrates, and metal content, in thousand tons, was as follows:

Mine	Metal content of mine output (thousand tons)					
	Copper	Cobalt	Nickel	Lead	Zinc	Pyrite
Outokumpu-Keretti	1.2	1.2	--	--	1.1	--
Outokumpu-Vuonos	9.4	--	1.0	--	2.5	--
Hammaslahti	4.7	--	--	--	--	--
Vihanti	3.7	--	1.1	--	35.6	--
Kotalahti	1.0	--	3.5	--	--	--
Virtasalmi	2.0	--	--	--	--	--
Pyhäsalmi	5.3	--	--	--	20.1	372
Hitura	--	--	1.2	--	--	--
Vammala (exploratory)	--	--	.4	--	--	--

Source: Outokumpu Oy. Annual Report, 1976, p. 22.

Chromium.—In 1976, chromite production increased significantly at Outokumpu Oy's Kemi mine near Tornio, where mining activity continued to shift increasingly to the Viianlahti-Viiaranta ore body. The mine produced chromium ore concentrate and some foundry sand. Some of the chromite concentrate produced at Kemi was processed into ferrochrome at the company's Tornio plant, but some chromite was also exported. Some of the ferrochrome produced at Tornio was processed into stainless steel at Outokumpu's stainless steel plant completed during 1976 at the same location.

Cobalt.—In 1976, cobalt concentrate from Outokumpu Oy's Outokumpu-Vuonos and Outokumpu-Keretti mines was processed at the company's Kokkola metallurgical works on the Gulf of Bothnia.

Copper, Lead, Nickel, and Zinc.—In 1976, an additional 200,000-ton-per-year ore mill was commissioned at Outokumpu Oy's Pyhäsalmi, Pyhäjärvi copper-zinc-pyrite mine, and work continued at the Kokkola smelter on the company's powerplant project designed to supply low-pressure steam for heating the town of Kokkola. It was decided to discontinue nickel production at the company's Vuonos mine in 1977 and use the concentrator for processing Oy Lohja AB's Polinjärvi talc ore, yielding some nickel concentrate byproduct to be sent to the company's Harjavalta smelter. Opencast mining was ended at Hammaslahti during the year, but mining continued underground. Investigation of the Isoaho ore body proceeded at Vihanti near Raahe, while exploratory mining at the Vammala mine in the southwest went underground. It was decided to terminate uneconomical sulfur production at Kokkola in 1977.

In 1976, Outokumpu Oy continued to operate nine complex metal sulfide ore mines, one of them exploratory. Myllykoski Oy operated the Luikonlahti mine also near Outokumpu, accounting for 10% of Finnish copper output. Smelting and refining of copper and nickel concentrates was in the hands of Outokumpu Oy, at the Harjavalta and Pori refineries in southwest Finland. Domestic and imported zinc concentrates were refined at the company's Kokkola zinc works.

Iron Ore.—In 1976, Government-controlled Rautaruukki Oy's Rautavaara mine in Finnish Lapland completed its first full year of operation, thus filling the gap created by the closing of the company's Raajärvi mine. Development of the company's Mustavaara mine resulted in trial runs and some production. In addition, the company operated the Otanmäki mine in central Finland. These three mines were the only iron mines operating in Finland during the year.

Iron and Steel.—In the framework of

"Programme 1500," a long-term expansion program for the steel industry approved in 1970, capacity of Rautaruukki Oy's Raahe steelworks, near the northern end of the Gulf of Bothnia, increased to 1.7 million tons per year after the company's No. 1 blast furnace went back into service. The furnace was taken out of service for relining when the No. 2 furnace was commissioned in 1975. In the company's converter shop, a third basic oxygen converter was installed; in the rolling mill a new plate mill was commissioned, hot rolling of steel slabs was started, and the company's continuous-casting plant was expanded. Various improvements were added to the Hämeenlinna rolling mill located near Helsinki, and work started on the Oulainen spiral welded pipe mill near Raahe.

Another important event of the iron and steel industry in 1976 was the commissioning of Outokumpu Oy's stainless steel plant at Tornio.

In 1976, about half of Finland's pig iron and steel was still produced by Rautaruukki Oy's integrated steel plant at Raahe; the rest came from plants of the Ovako Group located at Immatra on the U.S.S.R. border, and at Turku and Koverhar in the southwest.

Titanium.—Rautaruukki Oy's iron ore mine at Otanmäki in central Finland produced byproduct titanium concentrate that was sold to Kemira Oy for processing into titanium dioxide at its Pori plant on the west coast.

Vanadium.—Development of Rautaruukki Oy's Mustavaara, Suomussalmi, vanadium mine advanced to such a level that trial runs could begin in 1976. When fully developed, the mine is to produce 3,000 tons of vanadium pentoxide and 200,000 tons of iron concentrate per year. Farther south, the company's Otanmäki, Vuolijoki, mine continued production of vanadium pentoxide in 1976.

NONMETALS

Cement, feldspar, fertilizer materials, limestone, pyrite, quartz, sulfur, talc, and wollastonite were the main nonmetallic minerals produced in Finland in 1976.

Fertilizer Materials.—Executive committees of the Ministry for Trade and Industry recommended continuation of two phosphate ore research and development projects: Rautaruukki Oy's Sokli (Savukoski, Lapland) phosphate ore project, and Kemira Oy's Siilinjärvi (Kuopio Province) apatite project.

In recent years, the U.S.S.R. has reduced phosphate rock exports to Finland making the country's domestic phosphate development projects more urgent. In the meantime, the development of mines has been postponed because of softening of phosphate prices. Kemira Oy, the country's largest fertilizer and chemical company, produced phosphoric acid and ammonia (200,000 tons per year) at Oulu on the west coast, and compound fertilizers at Kokkola, also on the west coast.

Pyrite and Sulfur.—Because of rising production costs and lower market prices, Outokumpu Oy decided to terminate production of byproduct sulfur and roasted pyrite from its pyrite ore. The company remained the country's only producer of sulfuric acid, partly from its smelter waste gases.

MINERAL FUELS

Heavily dependent on imported oil, Finland produced only a moderate amount of hydropower, fuelwood, and peat, supplying about one-seventh of the country's needs. The balance was supplied by imported crude oil and petroleum products, natural gas, coal, and coke. Table 4 shows supply and apparent consumption of fuel and power in Finland in 1975 and 1976.

Nuclear and Hydroelectric Power.—Construction continued on four nuclear powerplants: Two units of 660,000 kilowatts each at Olkiluoto on the west coast and two units of 440,000 kilowatts each at Loviisa on the south coast. Teollisuuden Voima Oy, the State industrial power company, contracted for the 660,000-kilowatt plants with Atomenergi, A.B. of Stockholm and for the 440,000-kilowatt plants with the U.S.S.R. Hydroelectric power supplied about 6% of the country's energy. Less than one-third of all electric power generated was hydroelectric. Only 60% of Finland's exploitable waterpower has been utilized. Development of the remaining resources has not been considered economical.

Peat.—In 1976, the country's first peat-fired powerplant was commissioned at the United Paper Mill in Simpele on the southeast border. Finland reportedly has

Table 4.—Finland: Supply and apparent consumption of fuels and power for 1975 and 1976

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood, wood waste, industrial waste [e]	Hydroelectric power
1975:						
Production [2]	3.6	--	--	--	2.1	1.5
Imports	24.8	4.6	19.3	0.9	--	(3)
Exports	.2	--	.2	(3)	--	(3)
Apparent consumption	28.2	4.6	19.1	.9	2.1	1.5
1976:						
Production [2]	3.3	--	--	--	2.1	1.2
Imports	26.4	3.7	21.3	.9	--	.5
Exports	1.5	--	1.5	--	--	--
Apparent consumption	28.2	3.7	19.8	.9	2.1	1.7

[e] Estimate.
[1] 1 ton of standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Includes only primary fuels and power.
[3] Less than ½ unit.

Source: Foreign Trade, Monthly Bulletin, December 1976; and Bulletin of Statistics, 1977, No. 6. Central Statistics Office of Finland, Helsinki.

some of the world's largest exploitable peat resources, estimated at 2.5 to 3.5 billion tons of standard coal equivalent (SCE).[4] By 1980, peat is expected to provide 5% of the country's energy needs, and is to be used mostly in smaller powerplants of local significance.

Petroleum and Natural Gas.—Government-owned Neste Oy remained the country's sole oil company. Its two refineries, having a total capacity of 15 million tons per year, were located at Porvoo on the south coast and Naantali on the southwest coast. About two-thirds of all crude oil was imported from the U.S.S.R., the rest came mostly from Saudi Arabia. All natural gas was imported from the U.S.S.R.

[4] Financial Times (London). Finland, Energy Policy. Jun. 10, 1976, p. 15.

The Mineral Industry of France

By Roman V. Sondermayer [1]

France produced only moderate amounts of domestic crude minerals but remained a significant processor of imported mineral commodities during 1976. However, the value of extracted minerals in France was significant to certain local areas in terms of their economic well-being and the employment provided.

The most prominent minerals and metals produced in France during 1976, with production expressed as approximate percentage of the world total, were as follows: Arsenic 23%; fluorspar 15%; diatomite 12%; gypsum 9%; uranium 8%; potash 7%; bromine and magnesium each 6%; carbon black, iron ore (gross weight), lead metal, lime, and talc each 5%; alumina, cobalt metal, cement, pig iron, salt, and zinc metal each 4%; and aluminum, anthracite, bauxite, cadmium, iron ore (iron content), and steel each 3%.

Principal events in the mineral industry included: Discovery of new lead-zinc-copper deposits in Brittany, initial operation of a pilot plant for production of alumina from clay, startup of a new steel blooming plant and a new zinc roasting plant, and closure of a potash mine and plant.

PRODUCTION

A general downward trend in production reflected economic problems in the country. Table 1 shows the latest figures on French mineral production. Both private companies and the Government, through State-owned corporations, produced mineral commodities at home and abroad. The Bureau de Recherches Géologiques et Minières (BRGM) was an important instrument of the Government in securing raw materials for the domestic economy by exploration and ventures abroad. The following tabulation shows major firms in the mineral industry and percent of domestic output:

[1] Physical scientist, International Data and Analysis.

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Alumina	Aluminium Péchiney, plant at Gardanne, Péchiney Ugine Kuhlmann (PUK) 100%	100
Aluminum	Aluminium Péchiney, 10 plants, largest at Noguères, PUK	100
Bauxite	Aluminium Péchiney, mines at Var, PUK 100%	70
Cement	Ciments Lafarge, 19 plants, largest at Saint Pierre	26
Do	Société des Ciments Français, 37 plants, largest at Airvault	25
Do	Société Anonyme des Ciments Vicat, 11 plants, largest at Montalieu-Bourvesse	24
Coal, lignite	Charbonnages de France, mines in northeast and north France, Government 100%	98
Copper	Compagnie Générale d'Electrolyse du Palais, electrolytic plant at Palais, Metallurgie Hoboken-Overpelt S.A. (Belgium)	97
Ferroalloys	Aciéries de Paris et d'Outreau, plants at Outreau and La Plaine-Saint-Denis, U.S. Steel Corporation	60
Do	Société Française d'Electrometallurgie, plants at Bellegarde and Aiguebelle-Montricher, PUK	20
Iron ore	Sacilor Aciéries et Laminoirs de Lorraine (SACILOR), mines in Moselle Department, public 45% and Compagnie Lorraine Industrielle et Financière 27%	40
Lead ore	Société Minière et Métallurgique de Peñarroya, mines at Malines and Largentière, Imetal SA 58.6%	99
Lead, smelter	Peñarroya, Imperial smelter at Noyelles-Godault, Imetal SA 58.6%	100
Natural gas	Société Nationale Elf Aquitaine (SNEA), gasfields near Lacq	40
Nickel	Société le Nickel (SLN), nickel refinery at Le Havre, Imetal SA 50% and SNAP 50%	100
Petroleum, crude	SNEA, oilfield east of Paris	90
Petroleum, refined	Compagnie Française de Raffinage (CFR), 3 refineries, largest at Gonfreville	23
Do	Shell Française, 3 refineries, largest at Petit Couronne	21
Do	SNEA, 3 refineries, largest at Feyzin	12
Potash	Mines de Potasse d'Alsace, mines near Mulhouse, Government 100%	100
Steel, crude	Union Sidérurgique du Nord et de l'Est de la France (USINOR), plant at Dunkerque, Denain Nord-Est Longwy 63%	37
Do	SACILOR, iron and steel plant at Boussange, public 45% and Compagnie Lorraine Industrielle et Financière 27%	28
Tungsten	Société Minière d'Anglade, mines at Salau	90
Uranium ore	Commissariat a l'Énergie Atomique (CEA), mine at La Crouzille, Government 100%	61
Uranium, yellow cake	Société Industrielle des Minerais de l'Ouest (SIMO), 3 plants, largest at Bessines	86
Zinc ore	Peñarroya, mines at Largentière, Malines, and Saint Salvy, Imetal SA 58.6%	95
Zinc, smelter	Société des Mines et Fonderies de Zinc de la Vieille Montagne, electrolytic refinery at Viviez, Société Générale de Belgique S.A. (Belgium)	37
Do	Compagnie Royale Asturiennes des Mines (RAM), plant at Auby, RAM (Belgium)	34

Table 1.—France: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum:			
Bauxite, gross weight ---thousand tons--	2,855	2,563	2,330
Alumina ---do----	1,280	1,250	1,184
Metal:			
Primary ---do----	393	383	385
Secondary ---do----	125	107	133
Antimony, smelter	3,117	2,727	4,500
Arsenic, white	6,850	e 7,000	e 7,000
Bismuth:			
Ore and concentrate, metal content ---kilograms--	80,000	e 80,000	e 80,000
Metal ---do----	57,000	56,000	63,000
Cadmium metal	644	455	532
Cobalt metal	769	702	725
Copper:			
Mine output, metal content	392	500	500
Metal:			
Blister (secondary)	9,298	2,803	4,294
Refined:			
Primary	22,558	19,496	19,295
Secondary	21,332	20,067	20,058
Total	r 43,890	39,563	39,353
Gold:			
Mine output, metal content ---troy ounces--	48,901	50,026	61,022
Metal e ---do----	48,000	50,000	61,000
Iron and steel:			
Iron ore and concentrate:			
Gross weight ---thousand tons--	54,260	49,647	45,181
Metal content ---do----	16,714	15,309	13,792
Pig iron ---do----	21,986	17,494	18,657
Ferroalloys:			
Blast furnace: Speigeleisen and ferromanganese ---do----	533	427	367
Electric furnace:			
Ferromanganese ---do----	8	12	12
Ferrosilicon ---do----	237	242	237
Ferrochrome ---do----	111	100	101
Other ---do----	92	85	98
Total electric furnace ---do----	r 448	439	448
Steel:			
Ingots and castings ---do----	27,023	21,530	23,221
Semimanufactures ---do----	21,896	17,558	19,459
Lead:			
Mine output, metal content	22,980	22,300	28,000
Metal, refined:			
Primary	124,305	101,552	118,406
Secondary	19,167	15,364	13,222
Antimonial lead (Pb content)	34,266	33,830	40,603
Total	177,738	150,746	172,231
Magnesium metal including secondary	6,531	7,532	8,006
Nickel, metal content of metallurgical products (pure nickel, ferronickel, nickel oxide)	8,702	10,857	12,313
Silicon	41,370	34,970	41,000
Silver:			
Mine output, metal content ---thousand troy ounces--	1,690	1,502	2,806
Metal (content of final smelter products) ---do----	3,462	3,446	3,677
Tin concentrate, metal content	142	49	--
Tungsten concentrate, metal content	714	619	798
Uranium:			
Mine output, metal content	1,716	1,854	2,077
Chemical concentrate, U content	1,608	1,675	e 1,675
Zinc:			
Mine output, metal content	14,583	13,810	34,700
Metal including secondary:			
Slab	276,520	181,130	233,500
Dust	9,670	8,770	7,830
NONMETALS			
Barite	109,281	92,000	150,000
Bromine, elemental	15,880	16,770	15,180
Cement, hydraulic ---thousand tons--	32,340	29,588	29,394
Clays:			
Bentonite [1]	18,665	e 20,000	e 20,000
Brick and tile clay ---thousand tons--	10,414	NA	NA
Ceramic and pottery clay ---do----	957		
Clay and marl for cement industry ---do----	15,409		

See footnotes at end of table.

Table 1.—France: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
NONMETALS—Continued				
Clays—Continued				
Kaolin and kaolinite clay, crude		723,311	e 750,000	e 750,000
Kyanite and andalusite		9,852	e 10,000	e 10,000
Refractory clay, unspecified	thousand tons	1,162	NA	NA
Diatomite		205,205	e 210,000	210,000
Feldspar:				
Crude		240,780	199,000	188,000
Marketable		2 105,562	NA	NA
Fertilizer materials:				
Crude (natural):				
Phosphatic chalk		r 19,120	18,230	28,250
Potash:				
Gross weight	thousand tons	13,362	12,235	10,272
K_2O equivalent	do	2,275	2,085	1,738
K_2O equivalent (marketable)	do	2,083	1,920	1,600
Manufactured:				
Nitrogenous, N content	do	1,898	1,648	1,494
Phosphatic:				
Superphosphate, gross weight	do	1,262	913	814
Thomas slag	do	2,915	2,164	2,298
Other	do	2,173	1,433	1,750
Potassic	do	2,079	1,918	NA
Mixed, gross weight	do	8,926	6,708	6,342
Ammonia (N content)	do	2,114	1,941	1,781
Fluorspar:				
Crude		688,728	730,000	675,000
Marketable e		r 422,000	r 918,000	354,000
Fly ash	thousand tons	e 4,000	NA	NA
Gypsum and anhydrite, crude	do	6,622	e r 6,200	e 6,200
Lime, quicklime, hydrated lime, including deadburned dolomite	do	5,103	4,438	4,588
Mica e		4,000	4,000	4,000
Pigments, natural mineral, iron oxides		8,123	NA	NA
Pozzolana and lapilli		759,188	694,000	717,000
Quartz and glass sand:				
Quartz 3		591,742	e 560,000	e 480,000
Glass sand	thousand tons	5,677	5,342	NA
Salt:				
Rock salt	do	250	180	280
Brine salt	do	1,151	986	1,067
Marine salt	do	1,080	1,127	1,431
Salt in solution	do	3,515	3,054	3,300
Total	do	5,996	5,347	6,078
Stone, sand and gravel:				
Building stone:				
Granite and similar stone	do	818		
Limestone	do	1,117		
Marble	do	259	NA	NA
Crushed limestone and granite	do	8		
Other	do	7,032		
Dolomite:				
For agriculture		306,507		
Crude for calcining		528,552	NA	NA
Other		563,216		
Total		1,398,275	NA	NA
Limestone, agricultural and industrial:				
For agriculture	thousand tons	481		
For iron and steel industry	do	10,577		
For lime and cement	do	31,831	NA	NA
For sugar mills	do	1,138		
Total	do	44,027	NA	NA
Road building, foundation and ballast (other than alluvial sand and gravel):				
Ballast	do	118,938		
Foundation material	do	11,877		
Ground rock for road filler	do	1,635		
Paving block and curbing	do	114	NA	NA
Slate:				
Roof	do	108		
Other	do	2		

See footnotes at end of table.

Table 1.—France: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
NONMETALS—Continued				
Stone, sand and gravel—Continued				
Other stone:				
Beach pebble	thousand tons	225	NA	NA
Marl	do	161		
Mine fill	do	7,594		
Sand and gravel:				
Industrial sands:				
Foundry	do	1,494		
Miscellaneous	do	621		
Other sand and gravel (alluvial)	do	260,592	e 270,000	e 270,000
Sulfur, byproduct:				
From natural gas	do	1,852	1,792	1,737
From petroleum	do	r 107	93	88
From unspecified sources	do	r 142	109	146
Total	do	r 2,101	1,994	1,971
Talc:				
Crude		309,080	285,000	246,300
Powder		298,335	241,130	255,800
MINERAL FUELS AND RELATED MATERIALS				
Asphaltic material [4]		116,166	96,770	94,180
Carbon black e		160,000	170,000	170,000
Coal:				
Anthracite	thousand tons	5,950	5,357	4,811
Bituminous	do	r 16,959	17,067	17,068
Lignite	do	2,759	3,186	3,188
Total	do	r 25,668	25,610	25,067
Briquets	do	3,415	2,795	2,516
Coke, metallurgical	do	12,282	11,445	11,312
Gas, natural:				
Gross production	million cubic feet	392,697	374,934	369,354
Marketed	do	269,414	259,844	250,450
Natural gas liquids:				
Natural gasoline and condensate	thousand 42-gallon barrels	r 4,120	4,258	3,956
Propane	do	1,810	1,645	1,608
Butane	do	1,928	1,844	1,781
Total	do	r 7,858	7,747	7,345
Peat	thousand tons	186	e 200	e 200
Petroleum:				
Crude	thousand 42-gallon barrels	7,870	7,491	7,710
Refinery products:				
Gasoline:				
Aviation	do	394	318	335
Motor	do	142,238	138,125	152,527
Jet fuel	do	25,937	28,130	28,099
Kerosine	do	348	282	866
Distillate fuel oil	do	337,067	273,384	309,401
Residual fuel oil	do	261,101	220,486	243,617
Lubricants	do	9,111	7,582	8,909
Other:				
Liquefied petroleum gas	do	32,661	32,180	33,809
Bitumen	do	22,504	21,040	20,825
Unspecified	do	77,242	26,881	50,016
Refinery fuel and losses	do	41,605	60,627	53,793
Total	do	950,208	809,035	902,197

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Includes smectic clay.

[2] Consists of material for the ceramic and glass industries and reportedly contains pegmatite.

[3] Data include quantity for glass industry as well as for ceramic use.

[4] Excludes bituminous material.

TRADE

During 1975, the latest year for which complete data were available, imports of minerals valued at $18.4 billion were 34% of the country's total imports. Fuels, mainly petroleum, accounted for 67% of mineral imports. The Middle East supplied crude oil and European countries were the major suppliers of metals. Exports of mineral commodities, largely to countries in Europe, were valued at $7.3 billion, 14% of total exports of France. Tables 2 and 3 show details on foreign trade of France.

Table 2.—France: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite	114,365	46,005	Switzerland 17,104; West Germany 10,930; Italy 5,521.
Oxide and hydroxide [1]	390,939	385,024	Netherlands 180,755; Spain 104,323; Italy 25,054.
Metal including alloys:			
Scrap	20,567	22,294	Italy 11,214; West Germany 6,100; Belgium-Luxembourg 2,709.
Unwrought	179,819	163,850	People's Republic of China 48,121; West Germany 24,468; Belgium-Luxembourg 24,008; Italy 21,807.
Semimanufactures	141,663	130,798	West Germany 38,093.
Antimony, including metal scrap	219	386	Netherlands 91; West Germany 79; United Kingdom 75.
Arsenic (anhydride)	9,311	8,940	Malaysia 1,998; Switzerland 765.
Beryllium ——value, thousands [2]	$16	$118	NA.
Bismuth, all forms	158	107	Italy 84.
Cadmium	150	226	United States 87; Belgium-Luxembourg 50; West Germany 46; Netherlands 25.
Chromium:			
Chromite	581	368	NA.
Oxide and hydroxide	170	127	Netherlands 49.
Metal	677	269	Italy 49; West Germany 47; Sweden 42; Poland 40; Netherlands 35.
Cobalt	552	461	Poland 110; U.S.S.R. 100; United Kingdom 72.
Columbium, all forms ——value, thousands [2]	$5	$28	NA.
Copper:			
Matte	557	397	Belgium-Luxembourg 207; West Germany 106.
Metal and alloys:			
Scrap	74,412	55,784	Belgium-Luxembourg 20,460; West Germany 18,286; Italy 11,584.
Blister and other unrefined	7,770	2,183	Belgium-Luxembourg 2,163.
Refined	5,927	881	West Germany 278; Belgium-Luxembourg 269; Italy 160; Netherlands 124.
Semimanufactures	86,757	79,176	West Germany 32,408; Netherlands 8,226.
Gallium [3] ——value, thousands [2]	$3,952	$5,055	Switzerland $5,008.
Gold:			
Ashes and sweepings ——kilograms	508	5,863	Switzerland 606.
Metal:			
For domestic use thousand troy ounces	104	107	Netherlands 51; Switzerland 37.
Temporary imports ——do	4,308	3,439	Switzerland 2,944.
Iron and steel:			
Iron ore ——thousand tons	19,833	16,016	Belgium-Luxembourg 13,301; West Germany 2,711.
Pyrite cinder ——do	29	NA	
Metal:			
Scrap ——do	3,724	2,810	Italy 2,180; Belgium-Luxembourg 282; West Germany 200.
Pig iron including spiegeleisen [4] do	359	221	Italy 106; Belgium-Luxembourg 68.
Ferroalloys ——do	654	429	West Germany 101; Italy 87; Belgium-Luxembourg 53.
Shot and powder ——do	36	31	West Germany 13; Italy 6.
Steel, primary forms including coil do	1,115	1,414	Italy 492; Belgium-Luxembourg 167; West Germany 144.
Semimanufactures:			
Bars, rods, wire rods, sections do	3,644	2,709	West Germany 508.
Universals, plates, sheets——do	3,662	2,670	West Germany 604; Italy 290.
Hoop and strip ——do	462	383	West Germany 111; Italy 61; Belgium-Luxembourg 56.
Rails and accessories——do	331	318	Italy 42; Republic of South Africa 42.

See footnotes at end of table.

Table 2.—France: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures—Continued			
Wire ----------thousand tons--	177	114	West Germany 31; United States 22.
Tubes, pipes, fittings------do----	1,156	1,218	U.S.S.R. 166.
Castings and forgings, rough do----	80	81	Belgium-Luxembourg 30; West Germany 17; United States 13.
Lead:			
Ore ----------	104	7,513	West Germany 5,265; Belgium-Luxembourg 2,008.
Oxides ----------	12,252	9,134	Netherlands 2,450; Czechoslovakia 2,321.
Metal including alloys:			
Scrap ----------	14,035	5,139	Italy 3,958.
Unwrought ----------	19,770	21,176	West Germany 5,811; Belgium-Luxembourg 5,408; Algeria 2,510; Morocco 2,189.
Semimanufactures ----------	2,071	1,525	Netherlands 293; Belgium-Luxembourg 249; Italy 222; Algeria 217.
Magnesium metal including alloys, all forms-	2,910	2,228	West Germany 681; Netherlands 412; Belgium-Luxembourg 261.
Manganese:			
Ore ----------	2,212	4,494	Portugal 2,450; Italy 842.
Oxide ----------	742	963	Upper Volta 253; Belgium-Luxembourg 225; Ivory Coast 137.
Metal including alloys, all forms -------	7,117	3,832	Italy 714; Sweden 685; West Germany 658; United States 499.
Mercury ----------76-pound flasks--	145	58	NA.
Molybdenum:			
Ore ----------	1	NA	
Oxide ----------	35	48	West Germany 20.
Metal including alloys, all forms -------	139	87	Netherlands 30; West Germany 23; Italy 11.
Nickel:			
Matte, speiss, etc ----------	138	NA	
Oxides ----------	553	486	Italy 220; United States 54.
Metal including alloys:			
Scrap ----------	3,405	1,744	West Germany 697; United Kingdom 253; Netherlands 212; Czechoslovakia 211.
Ingots ----------	7,247	5,235	West Germany 2,414.
Semimanufactures ----------	5,062	5,258	Belgium-Luxembourg 1,175; Spain 1,110.
Platinum and platinum-group metals including alloys----------thousand troy ounces--	182	186	Netherlands 41; Switzerland 38; Spain 23.
Selenium ----------	4	7	Netherlands 5.
Silver:			
Metal including alloys thousand troy ounces--	25,188	18,874	United Kingdom 7,597; Sweden 3,617.
Ashes and sweepings ----------do----	2,872	4,702	Spain 3,364; United Kingdom 697; West Germany 552.
Tantalum, all forms------value, thousands [2]--	$230	$109	NA.
Thorium oxide ----------	39	276	Hong Kong 147.
Tin:			
Ore ----------	209	81	All to Spain.
Oxide ----------	64	43	West Germany 42.
Metal including alloys:			
Scrap ----------	613	479	Algeria 118; Belgium-Luxembourg 58; Netherlands 50.
Ingots ----------	520	483	Italy 157; United Kingdom 118; Netherlands 50.
Semimanufactures ----------	1,336	175	Spain 22; West Germany 18.
Titanium:			
Ore ----------	372	515	Algeria 325.
Oxide ----------	17,455	8,979	West Germany 1,793; United States 1,213; United Kingdom 941.

See footnotes at end of table.

Table 2.—France: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Titanium—Continued			
Metal, all forms	786	432	United Kingdom 154; Italy 100; West Germany 48.
Tungsten:			
Ore	1,067	1,398	West Germany 1,282.
Oxide	20	1	NA.
Metal, all forms	602	278	West Germany 109; United States 55.
Zinc:			
Ore	18,939	17,361	Italy 16,760.
Matte	1,005	1,100	West Germany 398; United Kingdom 318; Italy 147.
Oxide	NA	NA	
Metal including alloys:			
Scrap	1,276	2,847	Belgium-Luxembourg 1,620; Italy 665; West Germany 409.
Dust (blue powder)	5,889	2,739	Poland 1,114; Norway 416; Belgium-Luxembourg 348; Switzerland 282.
Slab and ingot	29,425	18,089	West Germany 4,522; United States 3,176.
Semimanufactures	24,549	25,693	West Germany 9,032; Belgium-Luxembourg 8,278.
Zirconium:			
Ore	3,779	798	Italy 644.
Oxide	191	126	West Germany 33; Spain 28.
Metal including nuclear grade	239	184	United States 100; Sweden 35.
Other:			
Ores and concentrates	4,067	135	NA.
Ash and residue from nonferrous metals:			
Aluminum	8,499	6,740	Italy 5,344; West Germany 827.
Copper	10,682	8,758	Belgium-Luxembourg 4,870; West Germany 2,268.
Lead	9,051	4,172	Belgium-Luxembourg 3,983.
Nickel	638	452	West Germany 256; Netherlands 96.
Zinc	12,964	9,632	Belgium-Luxembourg 5,234; West Germany 1,942; Sweden 1,783.
Other	24,050	19,629	Belgium-Luxembourg 11,118; Sweden 6,087; West Germany 1,052.
Ashes, sweepings, and other residues of platinum, silver, and other precious metals	2,019	146	United Kingdom 22; West Germany 17.
Slag and ash, n.e.s	45,240	84,643	West Germany 49,043; Belgium-Luxembourg 34,068.
Metals including alloys, all forms [5]	356	377	West Germany 146; Yugoslavia 130; Belgium-Luxembourg 56.
NONMETALS			
Abrasives, natural:			
Pumice, emery, other	2,011	341	NA.
Dust and powder of precious and semi-precious stones ----value, thousands [2]	$673	$549	Spain $274; Switzerland $150; Netherlands $90.
Grinding and polishing wheels	4,163	4,079	West Germany 541; Belgium-Luxembourg 508; Italy 500.
Asbestos, crude	317	2,050	Pakistan 637; Senegal 350.
Barite and witherite	25,217	22,552	Gabon 6,379; Italy 4,773; Belgium-Luxembourg 2,314.
Borates, natural	1,806	503	NA.
Cement ----------thousand tons	2,218	2,103	Ivory Coast 362; Algeria 339; West Germany 272.
Chalk	478,215	427,554	West Germany 182,175; Belgium-Luxembourg 85,036.
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin	135,397	110,954	West Germany 57,761; Italy 22,631.
Bentonite	3,564	7,182	Algeria 1,908; West Germany 982.
Refractory	3,160	2,338	West Germany 1,880.

See footnotes at end of table.

Table 2.—France: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Clays and clay products (including all refractory brick)—Continued			
Crude—Continued			
Other	604,757	247,584	Italy 126,120; West Germany 47,952; Belgium-Luxembourg 29,940.
Products, refractory (including nonclay brick)	482,191	478,463	West Germany 159,333; Belgium-Luxembourg 106,966.
Corundum:			
Natural including emery (included in Abrasives above)	433	396	Algeria 107.
Artificial	23,940	17,345	Italy 3,097; Belgium-Luxembourg 2,805; Austria 2,651; West Germany 2,000.
Cryolite and chiolite, natural	NA	445	NA.
Diamond:			
Industrial, excluding powder value, thousands [2]	$837	$1,222	Ireland $507; Belgium-Luxembourg $470.
Gem, unset ---do---	$18,143	$17,808	Switzerland $8,526; Netherlands $3,246; United States $2,020.
Diatomite	19,428	18,186	West Germany 8,777; Belgium-Luxembourg 2,998.
Feldspar	43,153	38,362	Belgium-Luxembourg 16,329; Spain 10,726; West Germany 6,560.
Fertilizer materials:			
Crude:			
Nitrogenous (natural sodium nitrates)	515	2	NA.
Phosphate rock	3,972	3,704	NA.
Potassic salts	24,148	11,994	Belgium-Luxembourg 10,620.
Organic	26,363	23,036	Switzerland 13,832; Belgium-Luxembourg 3,383; Spain 2,438.
Manufactured:			
Nitrogenous ---thousand tons---	559	575	Egypt 123; Belgium-Luxembourg 95; West Germany 90.
Phosphatic:			
Basic slag ---do---	286	198	Switzerland 105; Austria 45; Italy 44.
Other ---do---	124	100	Indonesia 20; Bangladesh 17; U.S.S.R. 15.
Potassic ---do---	789	742	Belgium-Luxembourg 333.
Ammonia, anhydrous ---do---	207	259	West Germany 104; Spain 35.
Flint (pebbles)	120,512	89,548	West Germany 26,037; United Kingdom 20,271; Belgium-Luxembourg 15,566.
Fluorspar	146,743	109,337	West Germany 71,676; Italy 12,059.
Graphite	1,079	589	Spain 142.
Gypsum and anhydrite, including plaster thousand tons	1,254	1,068	Belgium-Luxembourg 463; West Germany 185; Netherlands 177.
Iodine	14	61	United Kingdom 42.
Lime	398,602	236,133	Belgium-Luxembourg 105,305; West Germany 92,286.
Magnesite including calcined	664	516	NA.
Mica	2,967	2,746	United Kingdom 1,141; West Germany 513; Belgium-Luxembourg 304.
Pigments, mineral, including iron oxide	2,143	2,064	NA.
Pozzolan, santorin, etc	29,304	2,081	NA.
Precious and semiprecious stones, except diamond [6] ---value, thousands [2]	$20,768	$22,886	Switzerland $14,169.
Pyrite, gross weight	36	75	NA.
Salt	236,916	106,899	West Germany 47,311; Belgium-Luxembourg 21,193; Sweden 11,760.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	566,828	355,474	Australia 84,441; Guinea 62,368; Yugoslavia 41,269.
Caustic potash and peroxides of potassium and sodium	19,141	6,568	United Kingdom 928; Brazil 760.

See footnotes at end of table.

Table 2.—France: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Stone, sand and gravel: [7]			
Building stone:			
Crude and partly worked, n.e.s	113,336	103,160	Belgium-Luxembourg 59,984; West Germany 19,505.
Worked:			
Slate including crude	48,486	39,741	Netherlands 22,074; Belgium-Luxembourg 10,476.
Not specified	14,429	13,114	Belgium-Luxembourg 7,230; West Germany 3,530.
Dolomite, chiefly refractory grade	90,156	44,863	Belgium-Luxembourg 15,017; West Germany 12,265.
Gravel and crushed stone—thousand tons	12,676	11,921	West Germany 8,965; Switzerland 1,387.
Limestone (except dimension)	236,906	174,589	West Germany 88,339; Belgium-Luxembourg 83,312.
Quartz and quartzite	5,299	8,733	Belgium-Luxembourg 7,920.
Sand excluding metal bearing thousand tons	3,666	3,522	West Germany 2,004; Switzerland 666; Italy 537.
Sulfur, elemental ——do	871	539	United Kingdom 234.
Talc and steatite	76,432	63,397	West Germany 15,266; United Kingdom 11,601.
Other nonmetals, n.e.s.:			
Crude	277,353	263,020	Switzerland 240,095.
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture—thousand tons	1,161	1,021	West Germany 603; Belgium-Luxembourg 296.
Oxides and hydroxides of magnesium, strontium, barium	8,514	7,253	U.S.S.R. 3,265; West Germany 928.
Fluorine	1	23	NA.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	10,465	27,082	Belgium-Luxembourg 19,465; United Kingdom 6,645.
Carbon black	40,496	37,255	Spain 8,995; West Germany 8,357; Italy 5,841.
Coal and briquets:			
Bituminous	638,226	552,420	West Germany 329,088; Belgium-Luxembourg 115,598.
Briquets of bituminous coal	77,214	85,354	United Kingdom 61,725.
Lignite and lignite briquets	26,247	14,999	Spain 14,986.
Coke —thousand tons	1,013	719	Belgium-Luxembourg 233; West Germany 125.
Gas, natural —million cubic feet	4,485	5,372	Switzerland 2,763; Belgium-Luxembourg 2,598.
Hydrogen, helium, rare gases	798	935	Switzerland 491; Italy 156.
Peat including briquets	3,092	NA	
Petroleum refinery products:			
Gasoline —thousand 42-gallon barrels	21,046	15,785	Switzerland 4,607; West Germany 4,225; United Kingdom 2,924.
Kerosine and jet fuel ——do	5,532	7,270	Switzerland 2,573; West Germany 1,558; United Kingdom 984.
Distillate fuel oil ——do	28,438	26,841	West Germany 9,101; Switzerland 8,758.
Residual fuel oil ——do	15,271	21,345	West Germany 4,569; Italy 4,289; Sweden 2,897.
Lubricants ——do	3,267	2,771	Belgium-Luxembourg 473; United Kingdom 473; Netherlands 360.
Other:			
Liquefied petroleum gas ——do	6,622	5,881	Spain 2,900; Portugal 708.
Bitumen, petroleum coke, other residues ——do	3,005	2,479	West Germany 1,315; Switzerland 709.
Chemical derivatives of coal, petroleum, or gas	221,021	193,746	West Germany 124,479.

NA Not available.

[1] Excludes artificial corundum.

[2] Based on exchange rate of 4.8099 francs per U.S. dollar in 1974 and 4.80 francs per U.S. dollar in 1975.

[3] Includes indium and thallium.

[4] Including cast iron and shot, grit, powder, and sponge of iron and steel.

[5] Alkali, alkaline earth, and rare-earth metals except sodium and mercury.

[6] Including synthetic and reconstituted stone, but not including diamond.

[7] Not including slate, flint, or industrial limestone.

Table 3.—France: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite	1,012,251	1,456,000	Guinea 655,112; Australia 557,836.
Oxide and hydroxide [1]	14,162	15,708	West Germany 7,545; Netherlands 2,689; United States 2,605.
Metal including alloys:			
Scrap	27,203	25,190	West Germany 7,926; Belgium-Luxembourg 7,061; Netherlands 2,692.
Unwrought	262,882	217,903	Netherlands 59,543; West Germany 44,083; Greece 39,408.
Semimanufactures	132,703	107,442	West Germany 42,617; Belgium-Luxembourg 29,001; Netherlands 11,149.
Antimony:			
Ore and concentrate	8,104	5,045	Thailand 1,874; Bolivia 964; Australia 661; Republic of South Africa 560.
Metal, all forms	2,110	527	Belgium-Luxembourg 226; People's Republic of China 194.
Arsenic, anhydride and acid	20	2	NA.
Beryllium metal, all forms value, thousands [2]	$711	$406	United States $331.
Bismuth	1,259	640	Bolivia 217; Japan 135; Belgium-Luxembourg 128.
Cadmium	937	694	Belgium-Luxembourg 261; Japan 159.
Chromium:			
Ore	365,300	354,109	Malagasy Republic 103,701; U.S.S.R. 96,741; Republic of South Africa 54,911; Turkey 43,587.
Oxide and hydroxide	2,706	2,397	U.S.S.R. 955; West Germany 775; United Kingdom 521.
Metal, all forms	88	65	Japan 33; United States 21.
Cobalt:			
Ore	8,625	9,158	Morocco 9,154.
Oxide and hydroxide	296	170	Belgium-Luxembourg 168.
Metal, all forms	855	681	Zaire 197; United States 144; Belgium-Luxembourg 133.
Columbium:			
Ore (including tantalum ore) [3]	1,081	1,241	Canada 915; Gabon 208.
Metal, all forms—value, thousands [2]	$116	$187	West Germany $65; United Kingdom $59.
Copper:			
Ore and concentrate	501	879	West Germany 422; United Kingdom 210; Belgium-Luxembourg 103.
Matte	2,481	872	West Germany 422; United Kingdom 210; Belgium-Luxembourg 97.
Metal including alloys:			
Scrap	17,817	14,228	Belgium-Luxembourg 2,529; United States 2,466; West Germany 1,889.
Blister and other unrefined	42,001	26,777	Zaire 8,648; Chile 7,865; Belgium-Luxembourg 7,660.
Refined	377,458	2,816	Belgium-Luxembourg 1,065; Netherlands 909; United Kingdom 295.
Semimanufactures	97,240	92,400	Belgium-Luxembourg 41,777; West Germany 24,450; Italy 11,546.
Germanium, gallium, etc. value, thousands [2]	$988	$616	Belgium-Luxembourg $403.
Gold:			
Ash and sweepings—kilograms	1,213	6,213	Laos 568.
Metal:			
For domestic use thousand troy ounces	360	313	Netherlands 169; West Germany 95; United States 36.
Temporary imports—do	4,726	3,506	Switzerland 2,575; Republic of South Africa 365.

See footnotes at end of table.

Table 3.—France: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Iron and steel:			
Ore and concentrate, except roasted pyrite ---thousand tons--	15,822	13,169	Brazil 3,491; Mauritania 2,163; Liberia 1,994; Australia 1,676; Sweden 1,646.
Roasted pyrite	131,827	107,093	Italy 70,610; West Germany 31,628.
Metal:			
Scrap	328,123	278,066	Belgium-Luxembourg 143,900; United Kingdom 64,904; West Germany 54,379.
Pig iron, spiegeleisen, other [4] thousand tons--	332	329	West Germany 272.
Ferroalloys ---do---	197	204	New Caledonia 148.
Steel, primary forms ---do---	2,027	1,250	Belgium-Luxembourg 720; West Germany 364.
Semimanufactures:			
Bars, rods, sections [5] --do---	2,332	2,035	West Germany 763; Belgium-Luxembourg 747; Italy 267.
Universals, plates, sheets do---	3,153	2,594	Belgium-Luxembourg 1,159; West Germany 767.
Hoop and strip ---do---	431	266	Belgium-Luxembourg 141; West Germany 87.
Rails and accessories --do---	75	57	Belgium-Luxembourg 30; United Kingdom 20; West Germany 6.
Wire	154	115	Belgium-Luxembourg 48; West Germany 44.
Tubes, pipes, fittings --do---	443	401	West Germany 142; Italy 106.
Castings and forgings, rough do---	31,988	30,699	West Germany 14,493; Belgium-Luxembourg 5,004; Switzerland 3,875; Italy 3,599.
Lead:			
Ore and concentrate	165,544	129,803	Ireland 34,803; United States 28,381; Greenland 25,372; Morocco 17,255.
Oxide	2,982	1,475	East Germany 528; Belgium-Luxembourg 488; West Germany 166.
Metal including alloys:			
Scrap	21,755	12,599	Netherlands 3,946; Belgium-Luxembourg 3,122; West Germany 2,655; United Kingdom 1,826.
Unwrought	43,940	57,798	Belgium-Luxembourg 23,373; West Germany 12,589; United Kingdom 8,217.
Semimanufactures	1,192	734	Belgium-Luxembourg 533.
Magnesium including alloys:			
Scrap	329	271	Italy 223.
Unwrought	2,850	2,665	Norway 1,095; U.S.S.R. 914.
Semimanufactures	139	113	West Germany 43; United States 32.
Manganese:			
Ore and concentrate --thousand tons--	1,428	1,158	Republic of South Africa 544; Gabon 532.
Oxide	4,518	4,155	Spain 1,560; West Germany 979; Belgium-Luxembourg 764.
Metal, all forms	489	932	Republic of South Africa 751; Japan 122.
Mercury ---76-pound flasks--	9,747	7,774	Italy 3,713.
Molybdenum:			
Ore and concentrate	8,836	7,138	Canada 3,932; United States 1,537; Netherlands 1,206.
Oxide	134	136	Netherlands 119; Norway 17.
Metal, all forms	174	213	West Germany 99; Austria 34; Italy 25.
Nickel:			
Matte	13,377	15,202	New Caledonia 13,420.
Oxide and hydroxide	121	212	Canada 106; Belgium-Luxembourg 103.
Metal including alloys:			
Scrap	1,544	1,546	Belgium-Luxembourg 353; Spain 251; United Kingdom 182; West Germany 177.

See footnotes at end of table.

Table 3.—France: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Nickel—Continued			
Metal including alloys—Continued			
Unwrought	15,307	17,030	United Kingdom 4,773; Canada 2,787; New Caledonia 2,247; U.S.S.R. 1,967.
Semimanufactures (including anodes)	5,426	6,674	West Germany 2,333; United States 1,546; United Kingdom 1,183; Belgium-Luxembourg 729.
Platinum and platinum-group metals:			
Ashes and sweepings ____kilograms__	1,257	1,232	Netherlands 457; Greece 169.
Metals ____troy ounces__	350,668	377,739	United Kingdom 107,576; U.S.S.R. 52,888; Republic of South Africa 45,075.
Selenium	107	35	Japan 16; West Germany 6; Sweden 5; Mexico 3.
Silver:			
Ashes and sweepings ____kilograms__	18,084	19,783	Netherlands 7,033; Spain 5,755; Territory of Afars and Issas 5,000.
Metal, all forms thousand troy ounces__	38,056	35,076	India 9,420; United Kingdom 4,983.
Tantalum, all forms	37	23	United States 12; West Germany 8.
Thorium:			
Ore (monazite)	5,320	3,961	Australia 2,451; Malaysia 845; Brazil 548.
Metal ____value, thousands [2]__	(6)	NA	
Tin:			
Oxide	209	193	West Germany 88; Belgium-Luxembourg 54; Italy 51.
Metal including alloys:			
Scrap	149	310	Italy 211; Switzerland 74.
Ingots	12,019	10,143	Malaysia 3,706; Indonesia 1,962; People's Republic of China 1,461.
Semimanufactures	188	167	West Germany 117.
Titanium:			
Ore	176,359	117,414	Australia 116,164.
Oxide	31,857	22,393	West Germany 11,151; Belgium-Luxembourg 3,921; Netherlands 3,360.
Metal, all forms	1,607	2,415	U.S.S.R. 767; United States 443; United Kingdom 436; West Germany 420.
Tungsten:			
Ore	2,774	2,172	Republic of Korea 639; People's Republic of China 356.
Trioxide	72	6	NA.
Metal, all forms	134	119	West Germany 56; Netherlands 14; United Kingdom 11.
Uranium:			
Ore	1,647	1,882	Niger 1,875.
Metal including alloys____kilograms__	644,590	1,557,564	Republic of South Africa 501,221; Belgium-Luxembourg 381,176; United States 319,350.
Zinc:			
Ore and concentrate	540,499	389,779	Peru 102,609; Ireland 39,777.
Oxide	3,064	4,211	Belgium-Luxembourg 830; West Germany 747; Italy 631; United Kingdom 524; East Germany 518.
Metal including alloys:			
Scrap	23,885	13,276	Belgium-Luxembourg 4,473; Netherlands 4,127; West Germany 1,415.
Blue powder	4,844	2,538	Belgium-Luxembourg 2,260.
Unwrought	82,191	74,914	Belgium-Luxembourg 30,840; Netherlands 11,241; Republic of Korea 9,862.
Semimanufactures	2,849	2,222	West Germany 1,527; Belgium-Luxembourg 538.

See footnotes at end of table.

Table 3.—France: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Zirconium:			
Ore	42,114	34,721	Australia 31,532.
Oxide [7]	590	581	United States 392; United Kingdom 141.
Metal	62	178	United States 174.
Other:			
Ores and concentrates	12,520	8,407	Tunisia 2,951; Ireland 1,486; Greece 1,009; Australia 1,006.
Ashes and residues containing nonferrous metals:			
Aluminum	11,250	9,838	Italy 2,670; Netherlands 2,462; Belgium-Luxembourg 2,025.
Copper	683	1,660	Belgium-Luxembourg 1,059; Italy 530.
Lead	14,688	1,306	Switzerland 450; West Germany 401.
Nickel	129	12	Republic of South Africa 3.
Zinc	32,087	1,116,044	Belgium-Luxembourg 1,099,314.
Other	14,567	4,578	Italy 1,998; Kuwait 1,404; West Germany 576.
Metals including alloys, all forms	72	253	West Germany 156; Brazil 67.
NONMETALS			
Abrasives:			
Emery, natural corundum, other	47,337	1,288	Japan 1,123; West Germany 155.
Pumice	6,705	15,067	West Germany 7,189; Belgium-Luxembourg 6,370.
Dust and powder of precious and semiprecious stones—value, thousands [2]	$9,133	$6,012	United States $3,515; Republic of South Africa $1,193; Netherlands $963.
Grinding and polishing wheels	6,831	7,205	Belgium-Luxembourg 2,435; Italy 1,610; West Germany 1,438.
Asbestos	177,707	138,637	U.S.S.R. 55,024; Canada 43,345; Republic of South Africa 17,296; Italy 13,775.
Barite and witherite	77,584	44,429	People's Republic of China 34,101; West Germany 5,286.
Boron materials:			
Crude natural borates	182,825	111,273	United States 58,107; Turkey 51,799.
Oxide and acid	2,196	1,049	Italy 682; United States 215.
Bromine	292	673	Israel 391; United Kingdom 282.
Cement	32,407	31,399	Belgium-Luxembourg 18,620; West Germany 6,237; Italy 4,128.
Chalk	21,177	31,067	West Germany 22,575; Belgium-Luxembourg 8,317.
Clays and clay products:			
Crude:			
Kaolin including calcined	353,893	278,500	United Kingdom 201,526; United States 49,270.
Bentonite	117,099	102,423	Italy 37,174; Greece 31,226; West Germany 15,069; United States 11,708.
Clay and construction materials (bricks, etc.)	885,064	725,817	West Germany 273,601; Italy 261,741.
Cryolite and chiolite, natural	1,054	1,246	Denmark 1,114.
Diamond:			
Industrial, except dust value, thousands [2]	$7,022	$7,785	Ireland $2,722; Belgium-Luxembourg $2,540; United Kingdom $1,677.
Gem, unset ——do——	$83,435	$94,564	Belgium-Luxembourg $35,414; Switzerland $20,661; Israel $16,680.
Diatomite	6,116	7,688	United States 3,004; West Germany 1,658; Algeria 1,157; Spain 1,002.
Feldspar	15,211	8,669	West Germany 4,962; Portugal 1,732.

See footnotes at end of table.

Table 3.—France: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Fertilizer materials:			
Crude:			
Nitrogenous (natural sodium nitrate)	18,197	9,199	Chile 9,155.
Phosphate rock --thousand tons--	5,861	3,452	Morocco 1,298; United States 496; Senegal 485.
Manufactured:			
Nitrogenous	587,133	648,236	Belgium-Luxembourg 261,880; Netherlands 150,271; Romania 72,936.
Potassic	377,686	404,440	Israel 133,987; Congo 94,758; Belgium-Luxembourg 89,578; U.S.S.R. 54,138.
Phosphatic:			
Basic slag	675,400	507,691	Belgium-Luxembourg 507,409.
Other	450,976	248,136	Belgium-Luxembourg 76,724; Netherlands 42,999; United States 41,729; Senegal 35,272.
Ammonia	343,630	295,696	Belgium-Luxembourg 108,629; Netherlands 77,423.
Flint (pebbles)	1,012,739	884,161	United Kingdom 873,383.
Fluorspar	4,343	16,089	Morocco 10,469; Italy 2,898.
Graphite	8,859	6,564	Malagasy Republic 1,899; People's Republic of China 1,887; Italy 842.
Gypsum and plaster	8,289	14,081	West Germany 5,795; Italy 2,448.
Iodine, crude	1,200	510	Japan 436; Chile 68.
Lime	150,404	152,143	Belgium-Luxembourg 104,708; West Germany 45,152.
Lithium and strontium minerals	5,810	856,045	Switzerland 652,997.
Magnesite including calcined	68,089	74,591	Japan 15,600; Austria 14,284; Greece 12,930; United Kingdom 10,813.
Mica	7,598	9,250	India 7,499.
Pigments:			
Earth pigments, including iron oxides	1,091	613	NA.
Earth, other (pozzolanic), santorin, etc	3,806	NA	
Precious and semiprecious stones [8] value, thousands [2]	$43,226	$52,292	Switzerland $18,736; India $15,738.
Pyrite	88,959	52,374	Norway 34,196; Spain 7,617; U.S.S.R. 7,041.
Salt	162,089	131,414	Belgium-Luxembourg 70,273; Netherlands 42,338.
Sodium and potassium salts, n.e.s.:			
Caustic soda	98,722	78,815	Belgium-Luxembourg 33,413; West Germany 32,852.
Caustic potash and peroxides of potassium and sodium	498	400	West Germany 238.
Stone, sand and gravel: [9]			
Dimension stone:			
Crude and partly worked:			
Slate	5,509	4,502	United Kingdom 3,365.
Other	258,540	192,072	Italy 56,625; Republic of South Africa 51,937; Norway 27,858.
Worked:			
Slate	77,105	71,804	Spain 68,778.
Other	133,242	114,484	Italy 76,344; West Germany 28,660.
Dolomite, chiefly refractory grade	391,205	331,530	Belgium-Luxembourg 264,270; West Germany 62,502.
Gravel and crushed stone thousand tons--	4,612	4,273	Belgium-Luxembourg 3,924.
Limestone	249,356	227,967	Belgium-Luxembourg 227,941.
Quartz and quartzite	28,654	19,646	Italy 10,216; West Germany 7,382.
Sand excluding metal bearing thousand tons--	1,757	1,543	Belgium-Luxembourg 754; United Kingdom 410; Netherlands 309.
Sulfur, elemental, all grades	798,070	569,347	Poland 311,544; United States 109,753; Canada 103,920.
Talc and steatite	8,521	6,909	Italy 3,020; Belgium-Luxembourg 1,820; Norway 811.
Other nonmetals, n.e.s	840,763	106,364	West Germany 46,975; Greece 28,357; Republic of South Africa 15,457.

See footnotes at end of table.

Table 3.—France: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	2,662	2,615	United States 774.
Carbon black	66,518	63,688	Netherlands 32,904; West Germany 18,158.
Coal and briquets:			
Bituminous ---thousand tons--	16,259	17,282	West Germany 5,402; Poland 3,718; United States 3,409; U.S.S.R. 1,728.
Briquets of bituminous coal ---do---	81	59	West Germany 29; Belgium-Luxembourg 15; United Kingdom 15.
Lignite and lignite briquets ---do---	250	194	Mainly from West Germany.
Coke ---do---	4,603	2,885	West Germany 2,861.
Gas, natural ---million cubic feet--	323,430	366,599	All from Netherlands.
Hydrogen and rare gases	22,450	18,841	West Germany 9,787; Belgium-Luxembourg 6,488; Netherlands 2,405.
Peat including briquets --thousand tons--	76	81	West Germany 48; Netherlands 15; U.S.S.R. 14.
Petroleum:			
Crude ---thousand 42-gallon barrels--	949,869	749,035	Saudi Arabia 242,445; Iran 93,996; Iraq 86,002.
Refinery products:			
Gasoline ---do---	13,124	15,190	West Germany 4,599; Italy 2,839.
Kerosine ---do---	893	961	Italy 318; Algeria 279; Netherlands 124; United Kingdom 116.
Distillate fuel oil ---do---	14,361	14,472	U.S.S.R. 6,289; Italy 3,805.
Residual fuel oil ---do---	16,617	20,546	Netherlands 4,635; U.S.S.R. 4,196.
Lubricants ---do---	813	500	Italy 93; United Kingdom 87; United States 87; Netherlands 73; Belgium-Luxembourg 67.
Other:			
Liquefied petroleum gas ---do---	2,339	2,777	U.S.S.R. 1,334; Venezuela 302.
Vaseline, waxes, petroleum coke, bitumen, mixtures of bitumen, etc ---do---	2,897	3,873	United States 2,727; West Germany 455.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	292,859	517,133	United States 307,330; Italy 91,683.

NA Not available.
[1] Excludes artificial corundum.
[2] Based on exchange rate of 4.8099 francs per U.S. dollar in 1974 and 4.80 francs per U.S. dollar in 1975.
[3] Includes vanadium.
[4] Includes cast iron and sponge, powder, etc., of iron and steel.
[5] Includes wire rod.
[6] Less than ½ unit.
[7] Includes oxides of germanium.
[8] Including synthetic and reconstituted stone, but not including diamond.
[9] Excludes flint and industrial limestone.

COMMODITY REVIEW

METALS

Aluminum.—French bauxite production declined in relation to the output in 1975, because certain mining operations were closed as reserves were exhausted. Four companies, Aluminium Péchiney, Société Anonyme des Bauxites et Alumines de Provence (SABP), Swiss Aluminium Ltd. (Alusuisse), and Comptoir d'Extraction et de Vente de Bauxite (CEVB), produced bauxite. Aluminium Péchiney was by far the largest producer, and its output accounted for 70% of the country's total bauxite production. Bauxite mines were located in the Departments of Var, Hérault, Bouches-du-Rhône, and Ariège. The following tabulation shows the various Departments' shares of total national output in 1976:

Department	Percent of total
Var	77.0
Hérault	14.5
Bouches-du-Rhône	8.0
Ariège	.5

Domestic production supplied about half the French requirements in 1976. Guinea and Australia were the largest foreign suppliers and accounted for 76% and 16% of French imports, respectively.

Three plants, owned and operated by PUK, produced alumina (about 1 million tons in 1976). The following tabulation shows the output and capacity of these plants:

Plant location	Percent of total production	Capacity (thousand tons per year)
Bouches-du-Rhône:		
Gardanne	60	720
La Barasse	27	350
Gard: Salindres	13	250
Total	100	1,320

During 1976, the alumina plants operated at about 90% of their installed annual capacity. The Netherlands was the largest purchaser of exported alumina (about 54% of the total), followed by Spain (about 17%).

In October 1976, PUK started operation of a pilot plant at Estaque in the Rhône Delta for the production of alumina, based on PUK's H+ process. This process uses sulfuric acid to break down the aluminum silicate found in clay and shales. The impure aluminum sulfate produced is converted to aluminum chloride by the addition of hydrochloric acid. The final product, alumina, is produced by recrystallization. PUK reported that, depending on the alumina content of the clay, 60 to 100 tons of clay is required to produce 20 tons of alumina. PUK officials expected the process to lessen the dependence of the aluminum industry on bauxite and perhaps to partially reorient alumina production toward utilization of shales and clays.

Iron and Steel.—The performance of the iron and steel industry was mixed. The production of iron ore declined, but steel production increased. A draft of the French National Economic Plan, released in 1976, projected an output of 34 million tons of steel by 1980; to increase capacity to this target figure, an investment of 16.4 million francs would be necessary. Other developments in the steel industry were as follows: A new blooming plant came onstream at facilities operated by Pompey Company; a renovated wire plant operated by USINOR started production at Longwy; and Société des Hauts Fourneaux Reunis de Saulnes et Uckange and Société des Hauts Forneaux de la Chiers/Société des Aciéries Trefileries de Neuves Maisons Châtillon started production at agglomeration plants at Uckange and Isbergues. Details on capacities of these new facilities were not available at yearend. Other large structural changes in the steel industry were postponed. In particular, the Fos plant near Marseilles, operated by Société Lorraine et Méridionale de Laminage Continu (SOLMER), was a victim of the recession; expansion plans, originally conceived for 1980–82, were indefinitely shelved.

Iron ore, with an average iron content of 30.2%, was produced from three major basins, the Est and Ouest Basins, both in northern France, and the Pyrénées Basin. The Est Basin, located in Lorraine, was the largest, accounting for about 96% of iron ore output. Because of the economic depression, activities at the mines were limited to maintain production but with no major projects for expanding output. At yearend, stocks at mines totaled 7.9

million tons of iron ore and employment was about 10,000 persons. Domestic iron ore supplied 75% of the total domestic demand. Imports of high-grade iron ore continued to increase to supply coastal steelplants and to blend with low-grade domestic ores. Principal suppliers of iron ore (more than 1.5 million tons) were Brazil, Mauritania, Liberia, Sweden, and Australia. France also exported large quantities of iron ore, principally to the nearby Luxembourg steel industry.

The French iron and steel industry was located in five geographical regions, as shown in the following tabulation, with production in thousand tons:

Region	1975		1976	
	Pig iron	Steel	Pig iron	Steel
East	9,870	10,235	10,316	10,932
North	5,541	7,072	6,145	7,932
Center	--	956	--	896
Southwest	224	160	195	138
Southeast	1,520	2,228	1,638	2,517
West	766	879	730	800

The principal steel producers, their production in million tons, and major plants were: USINOR (7.9) at Dunkerque, Longwy, Thionville, Denain, and Valenciennes; SACILOR (6.0) at Boussange near Grandrange, Usine de l'Orne-Amont (Homécourt), Rombas (Moselle), and Hagondange (Moselle); Société Lorraine de Laminage Continu (SOLLAC) (2.0) at Hayange, Knutange, Sermange, Ébange, and Florange, all in Moselle; SOLMER (1.6) at Fos-sur-Mer near Marseilles; and Creusot-Loire Entreprises S.A. (1.3) at Le Creusot, Saint Étienne, Leffrinckoucke near Dunkerque, Imphy, and Firkny (Loire).

The percentages of total steel production by various processes for selected years were as follows:

Process	1960	1970	1975	1976
Oxygen	0.6	29.0	63.4	68.3
Electric	8.6	11.0	14.2	14.2
Thomas	60.5	41.1	15.2	11.8
Martin	29.7	18.6	7.1	5.7
Other	.6	.3	.1	--

Lead.—France remained dependent on imports of lead concentrate to meet its smelter demand; in 1976 this dependence was over 80%. Canada, Greenland, Ireland, and Morocco were the principal suppliers.

Increased production by domestic mines resulted from a full year of operation at the Argentière mine without strikes. In addition, technical problems in the flotation plant at the Farges mine (Corrèze) were resolved. The following tabulation shows the output by mine in tons of lead concentrate:

	1975	1976
Argentière, Ardèche (Peñarroya)	25,750	32,600
Malines, Gard (Peñarroya)	2,700	3,000
Farges, Corrèze (Société Minère de Corrèze)	1,370	3,200

The largest producer of lead concentrate in France was Peñarroya. The Imperial smelter at Noyelles-Godault (annual capacity 130,000 tons), owned by Peñarroya, remained the only primary lead smelter in operation in the country. In addition, Peñarroya operated secondary smelters at Saint-Denis (Villefranche-sur-Saône) and Escaudoeuvres. Aggregate production from secondary plants, including lead content of antimonial lead, was 53,800 tons in 1976.

Imported lead supplied 21% of total domestic demand. The largest suppliers of lead and lead alloys were Belgium (39%) and West Germany (26%).

Nickel.—Construction by SLN continued on a plant for production of electrolytic nickel, located at Le Havre. This plant was scheduled to replace the existing one, which was unable to meet current market specifications for nickel. As in the past, French production of nickel metal was based on imported matte from the company's smelter in New Caledonia. Imports of nickel were 67% of the demand.

Tungsten.—Although France remained the principal producer of tungsten among European Economic Community (EEC) countries, imports were essential to meet the demand.

Two companies produced tungsten from two mines. Société Minière d'Anglade, with a mine at Salau (Ariège) in southwest France, was the principal producer. Preliminary reports indicated the discovery of an additional 200,000 tons of ore averaging about 2% WO_3 in this general area.

Zinc.—During 1976, principal events included discovery of complex lead-zinc ore bodies in Brittany, increased output of zinc concentrate from a new mine, and

startup of a new zinc roasting plant at Pas-de-Calais.

In Brittany at La Porte-aux-Moines (Côtes du Nord), BRGM announced discovery of an important ore body of complex sulfide ore. Preliminary results indicated reserves at 2 million tons with an average of 2.1% lead, 8.0% zinc, 0.6% copper, and 102 grams of silver per ton of ore. In addition, BRGM continued to explore, by underground working, copper-lead-zinc deposits at Bodennec (Finistère).

Although output of zinc concentrate increased 250% during 1976, imports still accounted for 86% of the demand. In 1976, most of the zinc concentrate was imported from Peru (23%), Canada (22%), Sweden (10%), Ireland (8%), and Morocco (6%). The sharp increase in zinc concentrate production resulted from the first full year of production of the Saint Salvy (Tarn) mine and its concentrator owned by Peñarroya. This mine should reach its capacity of 900 tons of ore per day by 1977. Saint Salvy ore reserves were estimated at 3 million tons with 9.5% zinc and 0.5% lead, and silver content of 80 grams per ton of ore. Output of slightly over 71,000 tons of zinc concentrate came from three mines and concentrators, as shown in the following tabulation, in tons:

	1975		1976	
	Concentrate	Zn content	Concentrate	Zn content
Saint Salvy (Tarn)	4,870	2,256	43,700	21,586
Malines (Gard)	14,523	6,814	19,210	8,690
Argentière (Ardèche)	6,903	3,561	8,460	4,424
Other	2,615	13,810	--	--

Peñarroya operated almost all the zinc mines in France during 1976.

A new 150,000-ton-per-year facility for roasting zinc concentrate and producing sulfuric acid came onstream in Pas-de-Calais. The plant was owned and operated by Société des Mines et Fonderies de Zinc de la Vieille Montagne.[2] At the electrolytic plant at Viviez (Aveyron), owned by Vieille Montagne, construction continued on a plant for treatment of residues from electrolysis. Capacity was not made public, and the startup is expected in 1977.

Zinc metal was produced in three electrolytic plants and one Imperial smelter facility. Approximately 88% of demand was met by domestic production of metal, which increased as a result of a decision of zinc producers not to hold down output when conditions on the market were difficult, as they did in 1975.

Vieille Montagne operated two electrolytic plants, one at Viviez (Aveyron) and another at Creil (Oise); RAM operated an electrolytic plant at Auby (Nord); and Peñarroya operated an Imperial smelter installation at Noyelles-Godault (Pas-de-Calais).

Countries of the EEC—Belgium, West Germany, and the Netherlands—were the largest suppliers of zinc metal and together provided for about 71% of total French zinc imports in 1976.

Other Metals.—The French metallurgical industry produced a variety of metals during 1976 from mostly imported ores. However, no major events were reported. Output of these commodities is shown in table 1.

NONMETALS

Barite.—French barite output increased during 1976 as a result of a full year of operation at the new open pit mine on the Rossignol deposit. During 1976, Talcs de Luzenac acquired majority shareholding in the Société des Mines de Garrot Chaillac and changed the name to Barytine de Chaillac. The remaining equity in the company was held by Beneki, Mines de Garrot, and BRGM.

Cement.—Approximately 82% of cement capacity was controlled by four companies. The two principal companies were Société des Ciments Français with 22 plants and Ciments Lafarge with 18 plants. France had a total installed capacity of 40.4 million tons of cement per year.

Fluorspar.—During 1976 no changes of importance were registered. Domestic output was more than adequate to meet demand, and France was a net exporter of fluorspar. However, production and consumption declined, mainly because of the economic slowdown. PUK remained among the largest producers of fluorspar; with operations at Tanneron (Var), Longeau (Haute-Loire), and Paulinet and Reyssas-Montroc (Tarn), it produced half of the total output. The other half of the French

[2] Mining Journal (London). Mining Annual Review 1977—France. June 1977, p. 516.

output was accounted for by Société Denain-Anzin Minéraux with operations at Escaro (Pyrenees-Orientales); Société Minière de Trébas in Tarn; Société Industrielle du Centre at Chaillac (Indre), and other small producers.

Potash.—Experiments for producing potash by solution mining were underway during 1976 in French potash fields. The new method was intended to produce from sectors of deposits that are not easily accessible. Leaching, according to preliminary results, should extend the life of some deposits. In addition, restructuring and concentration of production of potash continued. In 1976, the mine and plant at Bollwiller were closed, leaving three plants, Amélie, Marie-Louise, and Theodore, in operation. The Government-owned Mines de Potasse d'Alsace operated the three mines and was the sole producer of mined potash. Output at the mines declined mainly because of unfavorable market conditions. France was a net exporter of potash; the countries of the EEC were the principal purchasers and took 86% of total potash exports.

MINERAL FUELS

Coal.—Output of coal remained at the same level as in 1975, and the decline that started in 1960 appeared to be leveling off. Contrary to expectations, the recession did not cause a decline in energy consumption or coal consumption. High prices for imported liquid hydrocarbons were another factor in improved performance of the coal industry.

The French coal industry, mainly operated by the Government-owned Charbonnages de France, was concentrated in three basins: Nord-Pas-de-Calais (northern France), Lorraine (northeastern France), and Centre-Midi (central and southern France).

Production figures for various coal basins, by type of coal, are given in the following tabulation, in thousand tons:

	1974	1975	1976
Anthracite and bituminous coal:			
Nord-Pas-de-Calais	9,011	7,715	7,318
Lorraine	9,066	10,021	9,970
Centre-Midi:			
Aquitaine	1,184	1,084	1,067
Avergne	424	r 414	417
Blanzy	1,446	1,554	1,553
Cévennes	836	822	607
Dauphiné	375	384	407
Loire	554	420	540
Other	13	10	--
Total	22,909	22,424	21,879
Lignite:			
Centre-Midi: Provence	1,604	1,545	1,556
Region Landais	1,155	1,641	1,632
Total	2,759	3,186	3,188
Grand total	r 25,668	r 25,610	25,067

r Revised.

Source: Annales des Mines. September–October 1977, sec. 11, p. 99.

In general, operating mines were deep, gassy, and wet, with thin, almost vertical, seams. However, in thick horizontal seams the degree of mechanization was high, about 98%. In some of the mechanized sectors of French coal mines, productivity was outstanding. At one mine in the Lorraine Basin, productivity reached 100 tons per manshift.[3]

Salient statistics on the coal industry are shown in table 4.

Capacity of all coal washeries in France was 15,267 tons of crude coal per hour. Approximately 62% of treated coal was produced by dense media separation.

Coke.—In Lorraine, modernization was completed on ancillary facilities with repairs of the Coppee No. 3 coking battery at Carling. At the No. 2 coking plant at Carling, the first set of furnaces came onstream after repair. Rebuilding of furnaces continued at coking plants situated in the Nord-Pas-de-Calais Basin; in the same Basin the Waziers coking plant ceased production on December 15, 1976. Production of coke and semicoke in the three Basins and at the steel coking plants, in thousand tons, was as follows:

[3] Charbonnages de France. Rapport de Gestion 1976 (Paris). 1977, p. 65.

	1974	1975	1976
Basins:			
Nord-Pas-de-Calais	3,632	3,112	2,836
Lorraine	2,159	2,139	2,052
Centre-Midi:			
Aquitaine	358	414	399
Loire	132	--	--
Total	6,281	5,665	5,287
Coking plants at steel mills	5,398	5,325	5,572
Gas coking plants and independent producers	603	455	453
Grand total	12,282	11,445	11,312

Sources: Charbonnages de France. Rapport de Gestion 1976 (Paris). 1977, p. 74. Annales des Mines. September–October 1977, p. 177.

At yearend 1976, installed capacity at coking plants in French basins was about 17,225 tons of coke per day. During 1976, coking plants in basins operated at about 83% of installed capacity.

The outflow of coke and semicoke to various sectors of the economy, in thousand tons and percentage of total during 1974–76, was as follows:

	1974	Percent	1975	Percent	1976	Percent
Steel industry	3,629	55.3	2,638	54.3	2,873	54.5
Small industries	1,290	19.6	1,008	20.8	957	18.2
Other industries	232	3.5	157	3.2	132	2.5
Exports	964	14.7	642	13.2	880	16.7
Household consumption	451	6.9	410	8.5	429	8.1
Total	6,566	100.0	4,855	100.0	5,271	100.0

Source: Charbonnages de France. Rapport de Gestion 1976 (Paris). 1977, p. 74.

Natural Gas.—The most important events in the natural gas industry were related to construction of trunk pipelines, expansion and renovation of the distribution network, and construction of underground storages. During 1976, laying of pipe was completed between l'Horme-Saint Chamond, Saint Cézaire-Colomars, Marcq-Villeneuve-Asque, and This-Warcq; doubling of pipelines continued at trunklines in Vannes (between Noyal and Muzillac), Besançon (between Dannemarie and Besançon), Nevers (between Sauvigny and Saint-Éloi), Bourges (between Foëcy and Mehun), Tulle (between Thenon and Farges), Verdun-Tréport (between Bourseville and Mers), and in Lorraine and Alsace. In addition, work was completed on doubling of pipelines in Centre-Est and Charente and construction of the pipeline near Saint-Nazaire. Construction started on an additional 80,000 cubic meters of underground storage space for gas in the general area of Fos, a port on the Mediterranean Sea.

Domestic output provided about 32% of the apparent demand of the country. The Netherlands remained the principal supplier and accounted for 77% of total imports of natural gas.

Table 4.—France: Salient statistics of the coal industry

(Thousand metric tons unless otherwise specified)

	1974	1975	1976
Production, bituminous and lignite	r 25,668	r 25,610	25,067
Exports, bituminous, lignite, coke, briquet	1,755	1,372	1,636
Imports, bituminous, lignite, coke, briquet	21,193	20,420	21,765
Apparent consumption, solid fuels	45,218	44,732	45,196
Average number of days worked	230	234	233
Average daily output	112	109	107
Number of workers:			
Underground	42,106	41,032	37,697
Overall	87,166	85,413	80,733
Production per manshift:			
Underground ----kilograms--	2,931	2,889	2,916
Overall ----do----	1,869	1,888	1,918
Stocks at yearend	3,618	6,162	4,837

r Revised.

Based on existing plans, natural gas should provide 16% of energy demand in 1985. To meet that target, France concluded a new agreement with Algeria to assure deliveries of 40 gigatherms per year until 1990. An additional 50 gigatherms per year will be delivered starting in 1980.

Petroleum.—With only a token domestic output of crude oil, France was heavily dependent on imports to meet demand in 1976. Principal sources of crude oil, domestic and foreign, are shown in the following tabulation, with percent of total refinery receipts:

	1975	1976
Europe:		
France	1.0	0.9
North Sea	.9	2.2
Spain	.2	.1
Total	2.1	3.2
Middle East:		
Saudi Arabia	32.3	36.4
Iraq	11.5	13.9
Iran	12.5	12.0
Other	23.0	18.9
Total	r 79.3	81.2
Africa:		
Nigeria	7.6	5.7
Algeria	4.8	3.6
Libya	2.1	2.5
Other	2.2	1.6
Total	r 16.7	13.4
Other:		
U.S.S.R	1.2	1.5
Venezuela	.7	.7
Total	1.9	2.2

r Revised.

To explore and develop new sources of petroleum and modify refinery capacity, large investments are necessary. The following tabulation shows investment in the French petroleum industry for selected years, in million current French francs:

The petroleum industry had economic difficulties caused by higher prices for imported crude oil and excessive capacity for refining, storing, and transporting liquid hydrocarbons. Although some increase in utilization of refinery capacities was reported in 1976, excess refinery capacity was available, resulting from lower consumption caused by conservation and the economic recession.

Exploration.—Expenditures in current francs for petroleum exploration and production increased 14% during 1976, although at yearend permits for exploration in force covered a total area of 109,718 kilometers, a decline of about 5% from that of 1975. Two new permits were granted for an area totaling 1,848 square kilometers in the Paris Basin and five new requests were submitted for exploration permits (four in the Aquitaine Basin and one in the Paris Basin). Geophysical exploration decreased 23% during the year to a total of 24.3 crew-months. Three wells completed showed encouraging signs of oil and gas (two in the Aquitaine Basin and one in the Paris Basin). However, two offshore wells in the Iroise Gulf were dry.

Production.—French companies produced crude oil in France and abroad. Domestic output was only about 0.9% of demand. The share of production from operations in which French companies had interest around the world amounted to about 78 million tons of crude oil in 1976, about 6 million tons less than that of 1975. The drop in French-controlled output abroad resulted from termination of contracts for coproduction in Algeria and termination of the concession of Basrah Petroleum Co. Ltd. in Iraq. New activities of French companies in Indonesia and the North Sea were expected to offset these losses of production in the future.

	1960	1970	1974	1975	1976 e
Exploration and production	383	362	231	350	400
Refining	217	1,534	1,460	1,054	995
Stocks and distribution	298	1,567	1,508	1,383	1,383
Pipelines	13	176	114	83	36
Tankers	206	510	1,837	1,550	1,294
Other investments	36	194	221	270	295
Total	1,153	4,343	5,371	4,690	4,403

e Estimated by Union des Chambres Syndicates de l'Industrie du Pétrol.

Source: L'Industrie Française du Pétrole (Paris). 1976, p. 36.

The following tabulation shows domestic output by basin and production by French companies abroad of crude oil, in thousand tons:

	1975	1976
Domestic production:		
Crude oil:		
Aquitaine Basin	797	824
Paris Basin	231	234
Total	1,028	1,058
Natural gas liquids from Lacq	761	661
Total domestic production	1,789	1,719
Production abroad by French interests:		
Europe	1,583	2,209
Middle East	53,690	47,598
Africa	26,759	24,839
Oceania: Indonesia	604	1,580
North America	1,953	2,100
Total production abroad	84,589	78,326

In Aquitaine, increased output was due principally to the initiation of production from the Castera-Lou Field, increased production from the Upper Lacq reservoir and higher yield from Bonrepos-Montastruc.

Refining.—Installed petroleum refining capacity remained the same as in 1975, although the official figure (171.7 million tons) shows an increase of 2.3 million tons of capacity. The difference resulted from expressing installed capacity for 1976 in terms of only one quality of crude oil, which previously was not done. The utilization of refinery capacity was 71%, approximately 7% more than in 1975, but this favorable trend cannot be considered permanent. The 1976 summer was dry and availability of hydroelectric energy was low. Consequently there was a greater demand for thermal power from plants fueled with liquid hydrocarbons.

French refinery capacity by process, in tons per day, on January 1 for selected years follows:

	1965	1970	1975	1976
Reforming:				
Thermal	6,785	1,900	--	--
Catalytic	21,910	39,025	58,290	58,290
Cracking:				
Thermal	7,300	6,600	6,600	5,600
Catalytic	16,332	18,788	28,720	28,720
Of which hydrocracking	--	--	2,200	2,200

The capacity for desulfurization in France was 63.7 million tons at yearend.

Table 5 shows location, ownership, and capacity of petroleum refineries in France.

Transportation.—On December 31, 1976, the French tanker fleet comprised 83 tanker ships with deadweight capacity of 15.5 million tons. The average tonnage of tankers was 186,700 tons. The ports of Marseille-Lavéra-Fos and Le Havre shared about 76% of total seagoing traffic in liquid fuels. During 1976, a new port for supertankers (500,000 deadweight tons) and large bulk carriers was commissioned at Antifer, north of Le Havre.

Several crude oil pipelines were in service with a total length of about 3,700 kilometers (including main line and connecting lines). The two largest pipelines were the Sud-European pipeline (1,702 kilometers) from Fos to Mannheim, West Germany, and the Île-de-France pipeline (87 kilometers) from Le Havre to Grandpuits. About 38 million tons were moved through the Sud-European pipeline and 7.8 million tons through the Île-de-France pipeline.

For transportation of petroleum refinery products, the Le Havre-Paris and Mediterranée-Rhône pipelines, with a total length of 1,768 kilometers, were used to move about 20 million tons of products.

In addition, about 30 tankers for liquid hydrocarbons, 4 tankers for liquefied gas, 534 riverboats, 13,022 railroad tank cars, and 4,094 tank trucks were used for movement of crude and products.

Uranium.—During 1976, the French Government placed industrial and commercial activities of the CEA in a new company, Compagnie Générale des Matières Nucleaires (COGEMA), leaving scientific and regulatory activities in the CEA. COGEMA was in charge of exploration, production, and beneficiation of uranium ores, production of nuclear fuels, and marketing of nuclear technology.

To meet long-range projections, which placed uranium demand at 10,000 tons per year by the year 2000, new sources of uranium would be required. Domestic exploration was intensified and efforts were made to assure supplies from abroad,

Table 5.—France: Location, ownership, and crude oil capacity of petroleum refineries for selected years

(Million tons)

Location	Ownership	1965	1970	1976
North:				
Flanders (Mardyck)	CFR	--	--	6.3
Dunkerque	Soc. Française des Pétroles BP	5.5	5.5	5.2
Valenciennes	Antar—Pétroles de l'Atlantique/Elf France	--	3.5	3.3
Vallée de la Seine:				
Normandie (Gonfreville)	CFR	10.2	14.3	23.3
Petit Couronne	Shell Française	5.5	9.2	18.8
Port Jerome	Esso S.A.F	4.0	7.2	7.2
N.-D.-de-Gravenchon	Mobil Oil Française	1.1	3.6	3.6
Vernon	Soc. Française des Pétroles BP	--	3.0	3.4
Vexin (Gargenville)	Elf France	--	3.6	5.7
Ile-de-France (Grandpuits)	----do	--	3.6	4.7
Atlantic:				
Donges	Antar—Pétroles de l'Atlantique/Elf France	3.9	4.6	8.3
Vern-sur-Seiche	----do	--	1.4	1.3
Pauillac	Shell Française	.5	.5	4.0
Bordeaux	Esso S.A.F	2.0	2.8	2.9
Ambès	Elf France	1.8	2.0	2.0
Mediterranean-Rhone:				
Frontignan	Mobil Oil Française	1.7	1.7	5.7
Berre	Shell Française	6.0	7.0	13.5
Lavéra	Soc. Française des Pétroles BP	4.4	4.4	11.5
Provence (La Mède)	CFR	6.4	10.2	10.5
Fos-sur-Mer	Esso S.A.F	--	3.0	8.0
Feyzin	Elf France	2.0	6.0	8.5
East:				
Herrlisheim (Strasbourg)	Raffinerie de Strasborg S.A	3.3	4.4	4.7
Reichstett (Strasbourg)	Cie. Rhenane de Raffinage	3.7	3.7	4.2
Lorraine (Hauconcourt)	Soc. de la Raffinerie de Lorraine	--	--	5.1
Total		62.0	105.2	171.7

mostly from former French colonies in Africa.

In France, COGEMA explored in the areas around its producing mines in the districts of Limousin, Vendée, and Forez. In addition, the company explored in Rouergue, Lauragais-Castrais, Berry, Bourbonnais-Morvan, and Les Vosges. Other companies, Minatome and Dong Thieu, explored south and west of the Central Massif in Bretagne and Aquitaine.

Most of the foreign exploration activities were in Gabon (near Franceville) and Niger.

Uranium in France was produced by COGEMA, Société Centrale de l'Uranium et des Minerais et Metaux Radioactifs (SCUMRA), Compagnie Française des Minerais d'Uranium (CFMU), Société Industrielle et Minière de l'Uranium (SIMURA), and Société des Mines d'Uranium du Centre (SMUC), a subsidiary of CFMU, COGEMA, and Société des Asphaltes du Centre.

The following tabulation shows mine production of uranium in France, in tons:

Company	Location of mine	Ore	Uranium content
COGEMA	Limousin	342,000	741
Do	Vendée	348,000	536
Do	Forez	126,000	460
CFMU	Lozère	137,000	162
Do	Creuse	15,000	50
SIMURA	Morbihan	7,000	36
SMUC	Corrèze	7,000	27
SCUMRA	Cantal-Creuse	33,000	65
Total		1,015,000	2,077

This tabulation does not include low-grade ores (0.02%) produced by COGEMA at Limousin and Vendée and by CFMU at Lozère.

COGEMA increased output in 1976 because of startup of a new extension to facilities at La Crouzille. Minatome started production from a small deposit at Saint-Pierre in Cantal and from another in the Department of Creuse. Dong Thieu started production from its property at Mailhac, and development by COGEMA of the Lodevois property in Hérault continued. According to plans, the Lodevois operation was scheduled to come onstream in 1980 and replace production from the Forez deposit whose reserves should be exhausted by that time.

Yellowcake from domestic ores was produced at three plants operated by SIMO and at the plant at Lozère. From imported raw materials (mostly from Gabon), COGEMA's plant at Guégon also produced yellowcake. The following tabulation shows production of concentrate expressed in tons of uranium content:

	1974	1975	1976
From domestic ores and liquids	1,540	1,731	1,813
From Gabon ores	436	597	606
Total	1,976	2,328	2,419

The Mineral Industry of Gabon

By Candice Stevens [1]

The mineral sector accounted for approximately 64% of Gabon's gross national product (GNP) in 1976, when the Government implemented measures to maximize revenues from its dominant petroleum industry. Increased Government participation, higher petroleum prices, and new reinvestment provisions were to provide the basis for an ambitious development program as outlined in the third 5-year plan (1976–80). The plan set forth two programs of investment based on differing estimates of future oil production. The basic plan, which projected investments totaling $3.5 billion,[2] was founded on a decrease in petroleum production to 8.3 million tons per year by 1980; an alternative plan, which would involve investments of nearly $4 billion, assumed that production would be maintained at the annual rate of 11 million tons through 1980 by the exploitation of new petroleum discoveries. In the 1976 budget which totaled $788 million, oil revenues accounted for $452 million (of which $260 million was derived from corporation taxes, $180 million from oil royalties, and $12 million from the Government's share in oil company profits).

A primary goal of the 5-year plan was economic diversification through the development of both infrastructure and the industrial base. The Provision pour Investissements Diversifiés (PID) required that oil companies reinvest up to 10% of their profits in domestic industrial ventures. The Gabonese Government would then acquire a 51% interest in all new projects, which were essentially tax-free. In the mineral sector, projects being financed with PID funds included the Compagnie Gabonaise-ELF de Raffinage (COGER) refinery, the Société des Ciments de Gabon cement plant at N'Toum, an ammonia fertilizer plant at Port-Gentil, and the Société Nationale de Transportation Maritime (SONATRAM) tanker fleet.

Mineral research and exploration were an important focus of the 5-year plan which allocated nearly $18 million for a general geological survey and mapping program and $23 million for petroleum and mineral prospecting. The Bureau de Recherches Géologiques et Minières (BRGM) (France) was to participate in prospecting for diamond in a 60,000-square-kilometer area in southern Gabon and for copper in the Nyanga syncline area near Mayumba, which was an extension of the Congolese Niari syncline. Cie. Minière de l'Ogooué, S.A. (COMILOG) was to undertake prospecting for copper and molybdenum in the Nouna-Ivindo region, for carbonatite in the Ngutu region, northeast of Okondja, and for kyanite at Etéké.

Further development of Gabon's mineral sector depended on the completion of the Trans-Gabon Railroad, which would link the manganese mines at Moanda, the uranium mines at Mounana, and the iron ore deposits at Belinga to a deepwater port under construction at Santa Clara, 15 kilometers north of Libreville. Construction began in January 1975 from points at Owendo, N'Djolé, and Franceville. The total length of 950 kilometers comprised a 340-kilometer link from Owendo to Booué, a 360-kilometer link between Booué, Moanda, and Franceville, and a 250-kilometer section connecting Booué and Belinga. The first link from Owendo to N'Djolé was to be inaugurated in early 1978. In 1976, a 13-

[1] Economist, International Data and Analysis.
[2] Where necessary, values have been converted from Communauté Financière Africaine Francs (CFAF) to U.S. dollars at the rate of CFAF242 = US$1.00.

company European consortium for the construction of the railroad completed site clearing, roadbed preparation, and bridge construction for laying the first section of track. The Gabonese Government was to finance the Owendo-Booué line and allocated $119 million of its 1976 budget to this undertaking. An additional $110 million was received from 13 lenders on the basis of agreements signed between 1973 and 1976, with the major share donated by the French Aid and Cooperation Fund.

Power-generating capacity of Société de l'Énergie et de l'Eau de Gabon (SEEG) increased from 50 million kilowatt-hours in 1966 to over 253 million kilowatt-hours in 1976. Gabon's first hydroelectrical power station was commissioned at Kinguélé in 1973 and supplied about 130 million kilowatt-hours of power in 1976 for the Libreville region. A second hydroelectric plant with a 69-megawatt capacity was to be constructed 30 kilometers upstream from Kinguélé in conjunction with a dam-reservoir complex scheduled for completion in 1979. During the year, Charles T. Main International (United States) was contracted for a feasibility study and financial plan for the Grand Poubara dam on the Ogooué River, 20 kilometers north of Franceville. The $300 million project would include an underground generating turbine with an eventual capacity of 210 megawatts.

PRODUCTION AND TRADE

Production of Gabon's major mineral commodities—manganese, uranium, and petroleum—remained at approximately the 1975 levels pending the completion of expansions in facilities and the Trans-Gabon Railroad. Manganese production was expected to increase from the 1976 level of 2.2 million tons to 3 million tons per year by 1980. Uranium metal production, which totaled 950 tons in 1976, was projected to reach 1,000 tons in 1978. Production of petroleum was expected to remain at the 11-million-ton-per-year level if new fields supplemented a decline in output from older fields. Construction of a second cement plant was to increase Gabon's cement production capacity from 270,000 tons in 1976 to 620,000 tons in 1979. Production of refined petroleum products was to reach 17 million barrels per year when a second refinery is brought into full production in 1977.

Gabon continued to evidence a favorable balance of trade in 1976 owing to increased mineral exports, which accounted for approximately 93% of total export values in 1976. Petroleum, which provided 83% of export earnings, was sold to the United States and Caribbean countries (30%), France (25%), Africa (25%), and Latin America and the Philippines (20%). Manganese was the second largest earner (8% of total export value) and was exported to the United States and Canada (42%), France (22%), Japan (12%), and other Western European countries. France remained the sole importer of Gabon's uranium production, which accounted for 2% of export value. France retained its position as Gabon's primary trading partner in 1976, being the largest recipient of exports and providing nearly 63% of Gabon's total import value. Approximately 55% of imports was capital goods required for construction of infrastructure and other development projects. Mineral products accounted for 10% of total imports. Gabon's major imports and exports are shown in tables 2 and 3.

The trading centers of Port-Gentil and Owendo were to be supplemented by a $100 million mineral port under construction at Santa Clara. Soros Associates (United States) was contracted to design the port, which was to handle tankers of 180,000 to 250,000 deadweight tons. Manganese, uranium, and iron ore were to be transported to the port by the Trans-Gabon Railroad for direct shipment. Petroleum was exported primarily from the Cap Lopez terminal north of Port-Gentil, which could stock up to 400,000 cubic meters of petroleum and could load tankers of up to 150,000 deadweight tons. The Gamba terminal farther south, from which approximately 25% of the petroleum was exported, had a capacity of 100,000 cubic meters and facilities for tankers of up to 80,000 deadweight tons. At yearend 1975, Gabon put into service the first in a planned tanker fleet, the *N-Tchengue*, which had a capacity of 140,000 deadweight tons.

Table 1.—Gabon: Production of mineral commodities

Commodity [1]	1974	1975	1976 [p]
Gas, natural:			
Gross production [e] ---million cubic feet--	19,000	21,000	64,488
Marketed production ---do---	1,611	1,675	[e] 5,962
Gold, mine output, metal content ---troy ounces--	[r] 8,906	3,987	3,086
Manganese:			
Ore, gross weight (50% to 53% Mn) --thousand metric tons--	2,059	2,182	2,152
Pellets, battery and chemical grade, gross weight (82% to 85% MnO_2) ---do---	70	46	65
Total ---do---	2,129	2,228	2,217
Petroleum:			
Crude ---thousand 42-gallon barrels--	[r] 73,913	80,390	82,042
Refinery products:			
Gasoline ---do---	1,116	1,097	1,260
Jet fuel and kerosine ---do---	746	753	870
Distillate fuel oil ---do---	1,832	1,864	2,845
Residual fuel oil ---do---	2,533	2,113	4,554
Other ---do---	56	44	695
Refinery fuel and losses ---do---	1,687	574	999
Total ---do---	7,970	6,445	11,223
Uranium oxide (U_3O_8), content of concentrate ---metric tons--	908	1,097	1,089

[e] Estimate. [p] Preliminary. [r] Revised.
[1] In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) is also produced, as well as diamond from artisan works, but output is not reported and available information is inadequate to make reliable estimates of output levels.

Table 2.—Gabon: Apparent exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
Iron and steel:		
Ore and concentrate	57,915	--
Metal, scrap	395	--
Manganese ore	1,466,890	1,291,573
Petroleum:		
Crude ---thousand 42-gallon barrels--	47,389	40,219
Refinery products, residual fuel oil ---do---	522	1,168
Uranium and thorium ores and concentrates ---value, thousands--	$12,269	$23,102
Zinc metal including alloys, unwrought	--	100
Other:		
Ores and concentrates	148	208
Crude minerals, n.e.s	4,053	3,646

Source: Statistical Office of the United Nations. 1974 and 1975 editions of the World Trade Annual, Walker and Co., New York. Vs. 1, 2, and 3.

Table 3.—Gabon: Apparent imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1974	1975
Abrasives, grinding and polishing wheels		15	24
Aluminum metal including alloys, all forms		311	462
Barite and witherite		5,567	6,379
Cement, hydraulic		40,029	109,852
Clays and clay products:			
Crude		--	1,121
Products:			
Nonrefractory		2,438	4,919
Refractory		100	87
Copper metal including alloys, all forms		77	98
Iron and steel semimanufactures		72,872	90,336
Petroleum refinery products:			
Gasoline	thousand 42-gallon barrels	82	--
Kerosine	do	153	--
Distillate fuel oil	do	241	--
Lubricants	do	32	26
Other	do	64	20
Sodium and potassium compounds, caustic soda		578	902
Titanium oxides and hydroxides		63	78
Other crude minerals		1,738	1,402

Source: Statistical Office of the United Nations. 1974 and 1975 editions of the World Trade Annual, Walker and Co., New York. Vs. 1, 2, and 3.

COMMODITY REVIEW

METALS

Iron.—A 15-month study was in progress in 1976 to determine the reserves and average phosphorus content of the iron ore deposits at Belinga in northeastern Gabon. During the year, the Gabonese Government announced its intention to yield part of its 56% interest in Société des Mines de Fer de Mékambo (SOMIFER) to Japanese firms. SOMIFER, a consortium of European interests and Bethlehem Steel Corp. (United States), scheduled exploitation of the deposits for 1982 in conjunction with the opening of the northeastern section of the Trans-Gabon Railroad. Total iron ore resources in Gabon were estimated at 1.2 billion tons. Reserves at Belinga were previously estimated at 566 million tons averaging 65% iron. An iron and steel industry was planned on the basis of iron ore production from the Belinga deposits reaching 12 million to 15 million tons per year. Exploration for iron ore was also being conducted in the Tchibanga region in southwestern Gabon.

Manganese.—Gabon was the fifth largest manganese producer in the world, with production totaling 2.2 million tons of metallurgical-grade ore and approximately 65,000 tons of chemical-grade ore in 1976. Reserves at Moanda, situated 50 kilometers west of Franceville, were estimated at 210 million tons of salable product grading 48% manganese dioxide. Open pit mining since 1962 has been under the direction of COMILOG, owned by United States Steel Corp. (44.1%), BRGM (19.8%), Cie. de Mokta (17.1%), the Gabonese Government (10%), and Société Auxiliare du Manganese de Franceville (9%). Ore was transported by a 76-kilometer overhead chain conveyer from Moanda to M'Binda on the Congolese border, then along a 286-kilometer stretch of the Chemin de Fer Congo-Ocean railroad for export from the port of Pointe-Noire. COMILOG continued its detailed geological study of the Okouma plateau north of Moanda and planned to invest $40 million over the next 4 years in the development of additional manganese deposits. The increased production, which was to eventually reach 4 million tons per year, would be transported by the Trans-Gabon Railroad to Santa Clara for export.

Manganese dioxide production was used by the Société Gabonaise des Piles (SOGAPIL) plant, completed in 1975. The plant, which had a production capacity of 6 million 1.5-volt batteries per year, was owned by the Gabonese Government (20%), Wonder (20%), and COMILOG (20%), with the remaining shares divided among private banks and individuals. Output, which was to be increased to 21 million

batteries of 4.5 volts, was sold for domestic use and exported to the Congo and Zaire.

A feasibility study on construction of a ferroalloys plant at Franceville was being conducted by Société Gabonaise des Ferroalliages (SOGAFERRO). Principal shareholders in SOGAFERRO were Okura Trading Co., Ltd. (25%), COMILOG (15%), the Gabonese Government (10%), Union Carbide Corp. (10%), Acièrs de Paris (10%), Elkem-Spigerverket A/S (Norway) (10%), Applications de la Chimie de l'Electricité et des Métaux S.A. (Sadacem) (Belgium) (10%), and an Italian firm (10%). Production of 85,000 tons of ferromanganese and 50,000 tons of silicomanganese was scheduled to begin in 1981. Four blast furnaces were to be powered by the 210-megawatt power station under construction at the Grand Poubara dam. The $75 million plant would produce ferromanganese and silicomanganese for export to the United States, Europe, and Japan.

Uranium.—Compagnie des Mines d'Uranium de Franceville (COMUF) planned to increase uranium metal production from 950 tons in 1976 to 1,000 tons in 1978 through underground exploitation of the Oklo mine. Shareholdings in COMUF were altered during the year to give the Gabonese Government 25%, Compagnie de Mokta 28.13%, the French Commissariat à l'Énergie Atomique (CEA) 15%, Minatome S.A. 13.12%, Compagnie Française des Minerais d'Uranium 7.5%, Cie. des Mines de Huaron 3.75%, and Compagnie de Gestion d'Investissements Internationaux (COGEI) 7.5%. COMUF mined the Mounana deposit, located 25 kilometers north of Moanda, from 1961 to 1975 and produced a total of 5,700 tons of uranium metal. Open pit mining at the Oklo deposit, discovered in 1968 about 2 kilometers south of Mounana, began in 1970. Preparations were underway for underground mining to begin at Oklo in 1978. Feasibility studies were being conducted on exploitation of the Boyindzi deposit, 400 meters north of Mounana, and the Okelobondo deposit, 500 meters south of Oklo. Total reserves at the three deposits were estimated at 20,000 tons of uranium metal.

Uranium exploration was continued by CEA, which held two prospecting licenses in 1976. A $4 million exploration program was being conducted in the Franceville concession which covered 45,000 square kilometers. CEA was negotiating with Union Carbide and Urangesellschaft mbH & Co. K.G. (West Germany) for partial financing of exploration in this area. Partners were also sought for investment in the Estuary concession covering 4,000 square kilometers in the Cocobeach region. The Gabonese Government was also discussing possible financing of uranium exploration and exploitation with the Iranian Government and the South Korean firm Ssangyong Co., Ltd.

Ore mined at Mounana and Oklo contained an average of 5% U_3O_8. The Mounana processing facility, which reached a capacity of 240,000 tons of ore in 1976, produced preconcentrates containing between 35% and 55% uranium. Final processing was done at the Gueugnon plant at Saône-et-Loire, France. A plant to produce yellowcake with a content of 70% to 75% uranium was scheduled for completion at Mounana in 1978. Capacity of the plant, which would cost $40 million, was to be 1,000 tons per year of contained metal.

The Gabonese Government concluded a new agreement with COMUF in January 1976, retroactive to January 1975. The agreement included provisions for construction of the yellowcake plant at Mounana, participation of the Gabonese Government in deciding prices and customers for uranium metal, preparation of a plan for "Gabonization" of the company and training of nationals, and sale of all output to CEA through yearend 1978. More significantly, Gabon's revenues from uranium production would be augmented by an increase in the gross profits tax from 25% to 50% and in the turnover tax from 12% to 28%.

NONMETALS

Cement.—Gabon's cement consumption increased from approximately 40,000 tons to 180,000 tons per year during 1966–76. In order to reduce its dependence on imported cement, Gabon undertook expansion of existing facilities and the construction of two new cement plants. Gabon's only clinker-grinding plant, owned by Société des Ciments d'Owendo, increased production capacity from 90,000 tons to 270,000 tons per year by the installation of an additional grinder in September 1976. Total production in 1976 was reported at 115,000 tons.

The expansion was funded by a $3.5 million loan from Caisse Centrale de Cooperation Economique (CCCE). Principal shareholders in the Owendo plant were the Gabonese Government (20%) and Ciments Lafarge S.A. (France) (71.3%).

Société des Ciments de Gabon was created in May 1976 to construct a cement plant utilizing limestone from deposits at N'Toum, where reserves were estimated at 20 million to 30 million tons. The cement plant, located 40 kilometers from Libreville, would produce 350,000 tons of clinker per year which would be processed at Owendo (250,000 tons) and at a new clinker-grinding plant to be built at Franceville (100,000 tons). Construction of the two facilities would be by Creusot-Loire Entreprise S.A. (France). Total costs, estimated at $70 million, were to be financed by a consortium of banks including the Banque de l'Union Européene and the Banque de Paris et des Pays Bas (Suisse) S.A. Shareholders in the N'Toum plant were the Gabonese Government (51%), Elf Gabon (19%), Ciments Lafarge (15%), and Société des Ciments d'Owendo (15%). Cement production for both domestic use and export was to commence in 1979.

Fertilizer Materials.—A plant to produce 60,000 tons of ammonia per year was under construction at Port-Gentil. The $27 million plant was owned by N'Ren Corp. (United States) (35%), Elf Gabon (31.85%), and the Gabonese Government (33.15%). Startup was scheduled for 1977 with the greater share of production to be exported to other African countries.

Marble.—A new marble cutting and polishing plant was completed at Tchwanga, near Doussé-Ossou, where reserves were estimated at 2 million tons. The plant was operated by Société Italo-Gabonaise des Marbres (SIGAMA), owned by the Gabonese Government (25%) and a consortium of Italian firms (75%). The $4.4 million plant was constructed by an Italian firm. Approximately 80% of the annual output of 40,000 tons per year was to be exported.

MINERAL FUELS

Natural Gas.—Gabon's natural gas reserves were estimated at 6.6 trillion cubic feet. Approximately 52 billion cubic feet of associated gas was produced during the year. Nearly 2 billion cubic feet was used to generate electricity in Port-Gentil and to power oil installations at Cap Lopez; the remainder of the output was flared.

Petroleum.—*Exploration.*—Oil exploration, which began in 1928 in Gabon, continued both onshore and offshore in 1976 under concessions granted to about 20 international companies (see table 4). Despite difficult physical conditions, the small size of deposits, and stringent Government terms, the number of companies engaged in exploration has steadily increased. The terms of the prospecting licenses required producing companies to reinvest up to 10% of their profits in domestic industrial enterprises, Government participation of 25% in case of commercial discovery, refining of 50% of crude output in local facilities, and training of local personnel. It was estimated that approximately $440 million would be spent on exploration in the period 1976–80. Prospecting licenses covered an area of 155,000 square kilometers and activity was concentrated in the coastal area and regions like the Nyembe forest near Lambaréné.

Elf Gabon was the most active company engaged in oil exploration, with shares in five offshore and three onshore concessions. In one of three offshore concessions held in conjunction with Mitsubishi Oil Co., Ltd., oil was struck in early 1976. Onshore, Elf Gabon was the operator for a group that struck an 850-barrel-per-day flow in the Olendé No. 1 well at the edge of the Ogooué area. Remaining shares in the concession were held by five U.S. firms—Ocean Drilling & Exploration Co. (ODECO), Ocean Oil and Gas Co., Murphy Oil Corp., Kewanee Industries, Inc., and Ensearch Corp.

Shell Gabon held one concession on its own, the Atlantique license, and shares in three other exploration permits. In 1976, Shell Gabon conducted an aerial photographic survey on 8,000 square kilometers in the Setté Cama region and completed a seismic survey on 450 square kilometers in the Ndogo Lagoon. Offshore, Shell Gabon concentrated its activity in the Mayumba Grand Fonds concession, held jointly by Elf Gabon, Gulf Oil Co. of Gabon, Hispanoil, and Shell Gabon.

In 1976, the Inguessi Marine concession, formerly held by Ashland Oil Inc., was acquired by British Petroleum Co. Ltd.

Table 4.—Gabon: Petroleum exploration concessions in 1976

Location	Operator/Shareholders	Expiration date	Area (square kilometers)
Port-Gentil, Nord et Sud	Elf Gabon/Mitsubishi	NA	4,774
Baudroie Marine	----do	NA	88
Merou-Sardine	----do	NA	208
Mayumba Grand Fonds	Elf Gabon/Gulf/Shell Gabon/ Hispanoil.	1977	950
Grand Large	Elf Gabon	1989	8,767
Ogooué [1]	Elf Gabon/U.S. consortium	1991	44,800
Setté Cama [1]	Shell Gabon/Elf Gabon	1991	10,350
Libreville	Shell Gabon/Gulf	1977	3,250
Atlantique	Shell Gabon	1991	16,847
Atlantique Profond	Gulf	1991	47,880
Banc du Prince	----do	1980	611
Iguela-Mayumba [1]	Gulf/Elf Gabon/Hispanoil	1977	3,050
Equata Marine	Chevron Oil Co./Texaco Inc	1978	1,610
Inguessi Marine	BP/West German consortium	NA	3,554
N'Gove	Petroleum Development Co	1980	736
Ogooué Marine	----do	1980	1,372
Ogooué Marine Sud	----do	1980	182
Nyanga Marine	----do	1981	1,868
Libreville Marine Ouest	Oceanic Exploration Co	1978	800
Cama Marine	Ashland	1984	1,619
Tassi Marine	Valmar Construction Co	1987	1,414

NA Not available.
[1] Onshore.

(BP) in partnership with three West German firms. Shares were divided among BP (30%), Wintershall Aktiengesellschaft (37%), Deutsche Schactbau und Tiefbohregesellschaft (16.5%), and Preussag Aktiengesellschaft (16.5%). Exploration was to begin in early 1977.

Production.—Petroleum production in Gabon, Africa's fifth largest producer and the most recent member of the Organization of Petroleum Exporting Countries (OPEC), remained at the 1975 level of approximately 11 million tons. Gabon began producing oil in 1957 with the development of inland deposits in the vicinity of Port-Gentil, and passed the symbolic 10-million-ton-per-year mark in 1974. Total production was maintained at this level owing to a series of small discoveries brought onstream in the past 2 years, but was expected to decline as a result of the depletion of older fields. The oil basin of Gabon, approximately 645 kilometers long and 241 kilometers wide, extends along the west African coast south of the Gulf of Guinea. Although there are a few large oilfields, most of the fields are of moderate size, and approximately 80% of oil production originates from offshore deposits (see table 5). Recoverable oil reserves were estimated at 100 million tons in 1976.

Three different types of crude were produced in Gabon: Mandji oil of 30° API gravity in the area of Port-Gentil, Gamba oil of 31.7° API gravity in the area near Setté Cama, and Lucina oil of 30.9° API gravity farther south near Mayumba. In 1976, the price of Mandji crude was raised 14% from $11.55 to $13.20 per barrel, and the price of Gamba crude was raised 13% from $12.00 to $13.50 per barrel. The largest producer in Gabon was Elf Gabon, a subsidiary of Essence et Lubrificants de France-Entreprise de Recherches et d'Activités Pétrolières (Elf-Erap), with about 85% of total production. Lesser producers were Shell Gabon, a subsidiary of Royal Dutch/Shell, with 12% of production, and Gulf, with 1% of production.

Elf Gabon, owned 25% by the Gabonese Government and 75% by Elf-Erap, operated 18 fields on its own and several others in conjunction with other companies. The largest producing field was Grondin, which accounted for about one-fourth of total Gabonese production from 20 wells. The Grondin Field, situated 80 kilometers south of Port-Gentil, was being used as a test site for deepwater production technology. In the same vicinity as Grondin were the Mandaros, Barbier, and Gonelle Fields; Gonelle was the latest in a chain of discoveries made south of Cap Lopez, beginning production in 1976 at a rate of 2,000 barrels per day. The three-field, offshore Anguille complex, located immediately southwest of Port-Gentil, was undergoing a water-injection program to

boost production. The combined flow rate of the Anguille Marine, Anguille Northeast, and Anguille Southwest Fields was about 43,000 barrels per day in 1976.

Two smaller fields to the north were brought onstream in 1976 by Elf Gabon, in conjunction with Mitsubishi. The Merou Field, located 105 kilometers south of Cap Lopez, started production in July 1976 at an initial rate of 1,000 barrels per day. The Baliste Field, 80 kilometers south of Cap Lopez, started producing in September 1976 at an initial rate of 2,000 barrels per day. Elf Gabon, in conjunction with the U.S. firms ODECO and Ocean Oil and Gas, also brought the offshore Breme Field near Batanga into production in 1976.

Shell Gabon, owned 25% by the Gabonese Government and 75% by Royal Dutch/Shell, started oil production jointly with Elf Gabon at the Gamba Field in 1963 and the Ivinga Field in 1968. In 1976, secondary recovery was being used to maintain production at the two fields, situated onshore near Setté Cama. The Lucina Field, located off the southern coast near the Congolese border, was brought into production in 1974 by Shell Gabon (50%), in a venture with Gulf (30%) and Elf Gabon (20%).

Table 5.—Gabon: Oilfields, 1976

Company and location	Discovery date	Date of first production	Average rate of production (barrels per day)	Gravity (°API)
Elf Gabon:				
Anguille Marine	1962	1963	43,000	29.9
Anguille Northeast	1968	1969		31.4
Anguille Southwest	1968	1969		33.4
Barbier [1]	1972	1974	2,000	31.0
Clairette [1]	1956	1957	1,500	29.9
Dorée	1972	1974	500	30.4
Girelle	1971	1974	7,500	32.6
Gonelle	1972	1976	2,000	23.5
Grondin	1971	1973	70,000	28.6
Lopez Nord [1]	1961	1962	2,000	23.9
Lopez Sud [1]	1958	1958	300	24.0
Mandaros	1972	1974	20,000	22.5
Pageau	1972	1974	15,000	18.2
Port-Gentil Ocean	1964	1965	3,750	33.1
Port-Gentil Sud Marine	1975	--	--	30.2
Tchengué [1]	1958	1959	2,000	30.6
Tchengué Ocean	1962	1963	1,500	30.5
Torpille	1968	1972	10,000	32.0
Elf Gabon/Mitsubishi:				
Merou	1968	1976	1,000	21.1
Baliste	1974	1976	2,000	27.2
Elf Gabon/Ocean/ODECO: Breme	1972	1976	3,000	32.0
Shell Gabon/Elf Gabon:				
Gamba [1]	1963	1963	20,000	32.4
Ivinga [1]	1967	1968	10,000	32.5
Shell Gabon/Gulf/Elf Gabon: Lucina	1971	1974	11,000	37.0

[1] Onshore.

Refining.—The refinery operated by Société Gabonaise de Raffinage (SOGARA) at Port-Gentil produced about 7 million barrels of refined products in 1976. The refinery was supplied with crude oil from the deposits of Mandji Isle by an 18-kilometer, 8-inch-diameter pipeline. SOGARA was owned 30% by the Gabonese Government, 18.75% by Elf Gabon, 18.75% by Compagnie Française des Pétroles, and the remainder by a group of petroleum marketing companies. About 40% of its production went to Société Nationale de Distribution Pétrolière, the Gabonese national oil distribution company, and the remainder was sold to Gabon's partners in the Central African Economic and Customs Union, which included Cameroon, the Central African Empire, Chad, and the Congo.

Preliminary trial operations at Gabon's second refinery at Port-Gentil began in June 1976, and production for export was to commence at yearend. The refinery was operated by COGER, owned 30% by the Gabonese Government and 70% by Elf Gabon. Capacity of the COGER refinery was 10 million barrels per year.

The Mineral Industry of East Germany

By Nikita Wells [1]

In 1976, East Germany remained the world's leading producer of lignite and the third largest producer of potash, producing approximately 28% and 13%, respectively, of total world output. Apart from these commodities, salt, building sand, and a moderate amount of natural gas that was discovered in 1971, East Germany can be considered relatively poor in raw materials and thus dependent upon imports for most of its mineral requirements. In 1976, the U.S.S.R. supplied 97% of East Germany's iron ore, about 40% of its pig iron and rolled steel, 87% of its crude oil, and about 40% of its natural gas. The U.S.S.R. also provided 60% to 70% of East Germany's nonferrous metal demand. In return for the raw materials, East Germany is helping to build projects in the U.S.S.R. such as the Orenburg gas pipeline, the Kiyembay asbestos complex, the Ust-Ilimsk pulp and paper complex, and several oil refining complexes, and is participating in the development of some iron ore deposits.

East Germany was stepping up its investments in developing the lignite mining industry, which is to continue to be its primary source of energy. Other major investments are concentrated on the petrochemical and chemical industry, metallurgy, exploration and exploitation of indigenous energy sources, and the potash industry. A special effort was also being made in recycling to derive secondary raw materials.

East Germany's national income grew 3.7% in 1976, 1.6% below the planned growth rate of 5.3%. This resulted mainly from the severe drought in the summer of 1976 that caused a sharp drop in agricultural output. Industrial production during the year increased 14 billion marks [2] or 5.9% over that of 1975.

PRODUCTION

East Germany's iron and steel industry showed a moderate increase in production in 1976. Crude steel increased 4.0%, pig iron 2.9%, and steel semimanufactures 7.3%. East Germany's iron ore resources are almost depleted and present production is low; production of most nonferrous metal ores is on the decline.

In the nonmetals industry, production of potash increased 4.7% over that of 1975. This was owing mainly to new developments at Kalibetrieb Zielitz potash combine. Production of nitrogen fertilizers in 1976 increased 44.2% over that of 1975 owing to the full operation of three new production units of the VEB Stickstoffwerk Piesteritz plant.

In the mineral fuels area, production of indigenous fuels remained constant.

Production statistics for many of East Germany's mineral commodities are not officially reported. Therefore, much of the data presented in table 1 are estimated.

[1] Physical scientist, International Data and Analysis.

[2] Because of fluctuating exchange rates, a meaningful conversion from East German marks to U.S. dollars is impractical. The published official exchange rate as of December 1976 was 2.40 marks = US$1.00.

Table 1.—East Germany: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum:			
Alumina ---tons	48,183	48,300	44,468
Metal, primary [e] ---do	70,000	70,000	70,000
Cadmium metal, primary [e] ---do	18	18	18
Copper:			
Mine output, metal content [e] ---do	--	1,500	1,500
Metal:			
Smelter [e] ---do	--	1,500	1,500
Refined [e] ---do	46,000	48,000	48,000
Iron and steel:			
Iron ore, gross weight [2]	53	59	--
Pig iron	2,280	2,456	2,528
Crude steel	6,165	6,472	6,732
Steel semimanufactures (rolled products, forgings, pressings)	4,099	4,281	4,594
Lead:			
Mine output, metal content [e] ---tons	4,000	[r] 4,000	4,000
Metal, refined, including secondary [e] ---do	[r] 35,000	[r] 36,000	36,000
Nickel [e] ---do	2,200	2,400	2,500
Silver, mine output, metal content [e] ---thousand troy ounces	[r] 2,000	[r] 1,800	1,600
Tin:			
Mine output, metal content [e] ---tons	1,200	1,200	1,200
Metal, including secondary [e] ---do	1,200	1,200	1,200
Zinc metal, including secondary ---do	18,000	18,000	18,000
NONMETALS			
Barite [e] ---do	31,000	31,000	31,000
Boron materials: Processed borax, $Na_2B_4O_7 \cdot 10H_2O$ content ---do	3,870	3,867	4,000
Cement, hydraulic	10,099	10,657	11,344
Chalk [e]	48	50	50
Fertilizer materials, manufactured:			
Nitrogenous, N content:			
Ammonium sulfate	163	164	165
Calcium ammonium sulfate	214	221	223
Unspecified	59	153	388
Total	436	538	776
Phosphatic, P_2O_5 content:			
Superphosphate	208	227	224
Calcined phosphate	121	112	111
Thomas slag	9	13	13
Unspecified	72	75	75
Total	410	427	423
Potassic, marketable potash, K_2O equivalent	2,864	3,019	3,161
Ammonia	838	1,117	1,361
Fluorspar	90	90	90
Gypsum and anhydrite:			
Crude [e]	340	340	340
Calcined	311	306	302
Lime and deadburned dolomite	3,027	3,030	3,404
Pyrite, gross weight [e]	140	140	140
Salt:			
Marine	51	51	52
Rock	2,287	2,380	2,508
Total	2,338	2,431	2,560
Sodium and potassium compounds:			
Caustic soda ---tons	436,204	442,314	440,589
Sodium carbonate ---do	804,080	818,208	828,998
Sodium sulfate ---do	195,931	166,787	149,218
Stone, sand and gravel:			
Crushed stone	12,061	12,930	13,836
Sand and gravel	7,737	7,978	8,218
Sulfur:			
Elemental	89	85	79
From pyrite [e]	58	58	58
Sulfuric acid	1,005	1,002	957
MINERAL FUELS AND RELATED MATERIALS			
Coal:			
Bituminous	594	540	550
Lignite	243,468	246,706	246,897
Total	244,062	247,246	247,447

See footnotes at end of table.

Table 1.—East Germany: Production of mineral commodities—Continued

(Thousand metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
MINERAL FUELS AND RELATED MATERIALS—Continued				
Coke:				
From anthracite and bituminous coal		1,829	1,779	1,693
From brown coal:				
High temperature		1,970	2,041	2,123
Low temperature		3,897	3,506	3,362
Total		7,696	7,326	7,178
Fuel briquets (from lignite)		50,061	48,938	48,679
Gas:				
Manufactured	million cubic feet	173,571	181,446	194,301
Natural, marketed production [e]	do	[r] 283,000	[r] 283,000	283,000
Petroleum:				
Crude [e]	thousand 42-gallon barrels	2,500	2,500	2,500
Refinery products:				
Gasoline	do	24,493	24,934	25,348
Kerosine, jet fuel, distillate fuel oil	do	34,003	36,884	38,823
Residual fuel oil	do	48,746	53,957	58,844
Lubricants	do	2,511	2,579	2,666
Asphalt	do	5,420	6,311	6,596
Total [3]	do	115,173	124,665	132,277

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the commodities listed, magnesium, peat, and a variety of crude nonmetallic construction materials (clays and stone) are produced, but output is not reported and available general information is inadequate for reliable estimates of output levels.

[2] Source indicates that data include "roasted ore," presumably roasted pyrite.

[3] Total of reported figures only; no estimates have been made for unreported products and/or refinery fuel and losses.

TRADE

In 1976, East Germany's total foreign trade turnover increased 14% over that of 1975, reaching 84.8 billion marks. In 1975, 69.7% of the trade was with other centrally planned economy countries, 25.9% was with developed market economy countries, and 4.4% was with developing countries. About 35.6% of the trade was with the U.S.S.R. alone.

East Germany's principal trading partners for 1975, in order of importance, with their respective values of total trade turnover in billion marks, were as follows:

U.S.S.R	26.5
Czechoslovakia	6.9
Poland	6.6
West Germany	5.0
Hungary	4.0
Bulgaria	2.4
Romania	2.0
Other	21.0
Total	74.4

East Germany incurred a record high trade deficit of $2.68 billion in 1976, approximately 50% above the 1975 deficit. This resulted mainly from sharp increases in the prices of raw materials supplied by Council for Mutual Economic Assistance (CMEA) countries,[3] especially the U.S.S.R.

In 1976, as in previous years, East Germany's mineral exports consisted mainly of potash, brown coal briquets, rock salt, kaolin, iron and steel semimanufactures, and some petroleum products. Only the exports of potash and brown coal briquets were of significance.

Of the large list of mineral imports, crude oil is the most significant with 18 million tons imported in 1976. Other important imports include natural gas, bituminous coal, coke, iron ore, pig iron, rolled steel, nonferrous metals, phosphate rock, apatite concentrate, and chemical products.

[3] Includes the following countries: Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.

Table 2.—East Germany: Exports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Oxide and hydroxide	2,994	NA	
Metal including alloys:			
Scrap	1,397	855	Netherlands 560; United Kingdom 295.
Unwrought	r 1,199	1,098	United Kingdom 688; Italy 356.
Semimanufactures [2]	8,697	2,460	All to Poland.
Copper metal including alloys:			
Scrap	NA	130	All to Belgium-Luxembourg.
Unwrought	377	153	United Kingdom 103; Austria 50.
Semimanufactures	259	34	All to Austria.
Iron and steel:			
Ore and concentrate ——thousand tons	2	19	All to Italy.
Scrap ——do	r 26	29	Italy 9; Yugoslavia 9; Finland 5.
Pig iron, ferroalloys, similar materials ——do	165	155	Sweden 76; Japan 48; Belgium-Luxembourg 12.
Steel, primary forms ——do	106	113	Yugoslavia 47; Spain 24; Italy 20.
Semimanufactures ——do	229	173	Yugoslavia 60; Bulgaria 37.
Lead:			
Oxides	794	926	France 528; Sweden 225; Denmark 173.
Metal including alloys:			
Scrap	150	NA	
Unwrought and semimanufactures	2,373	2,058	Austria 752; France 599; Italy 503.
Magnesium metal including alloys, all forms	57	NA	
Nickel metal including alloys	224	242	Netherlands 112; Belgium-Luxembourg 93.
Platinum-group metals and silver:			
Platinum-group ——value, thousands	NA	$59	All to Austria.
Silver ——do	$6,468	$202	United Kingdom $138; Austria $64.
Tin metal including alloys, all forms	7	NA	
Zinc:			
Oxides	1,372	2,205	Norway 938; France 518; Denmark 360.
Metal including alloys:			
Scrap	946	1,886	France 875; Belgium-Luxembourg 524; Netherlands 487.
Unwrought and semimanufactures	408	251	All to Belgium-Luxembourg.
Other:			
Ash and residue containing nonferrous metals	17,319	17,677	Austria 15,751; Netherlands 1,926.
Base metals including alloys, all forms, n.e.s	18	NA	
NONMETALS			
Abrasives: Grinding and polishing wheels and stones	45	56	All to Greece.
Asbestos	100	NA	
Barite	r 140	240	All to Belgium-Luxembourg.
Cement ——thousand tons	39	132	All to Hungary.
Chalk [2]	42,103	42,995	NA.
Clays and clay products:			
Kaolin [2]	95,443	80,250	NA.
Products:			
Nonrefractory	r 7,451	7,266	Belgium-Luxembourg 4,368; Denmark 1,348.
Refractory	r 5,366	4,759	Sweden 3,539; Belgium-Luxembourg 1,220.
Diamond, industrial ——value, thousands	$365	NA	
Feldspar and fluorspar	21,138	9,985	Austria 8,070; Belgium-Luxembourg 1,915.
Fertilizer materials:			
Crude ——thousand tons	46	28	United Kingdom 16; Austria 12.
Manufactured:			
Nitrogenous ——do	61	NA	
Potassic, crude and manufactured, K_2O equivalent [2] ——do	2,089	2,252	Poland 581; Czechoslovakia 521; Hungary 177.
Phosphatic, gross weight ——do	2	1	All to Netherlands.
Ammonia ——do	55	120	Denmark 76; Sweden 22; France 11.

See footnotes at end of table.

Table 2.—East Germany: Exports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Gypsum, calcined [2]	r 89,701	64,471	Sweden 2,902.
Mica, worked	6	NA	
Salt, rock [2] thousand tons	945	1,008	Czechoslovakia 810; Sweden 75.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	5,672	6,806	All to Hungary.
Caustic potash [2]	r 9,782	8,842	U.S.S.R. 1,219; India 111.
Soda ash [2] thousand tons	268	47	Finland 19; Sweden 17; Yugoslavia 6.
Stone, sand and gravel:			
Dimension stone, crude and partly worked	r 552	487	All to Norway.
Gravel and crushed rock:			
Gravel [2] thousand tons	354	341	NA.
Crushed rock [2] do	12	9	NA.
Sand, excluding metal bearing do	r 17	12	Austria 7; Yugoslavia 5.
Sulfur:			
Elemental do	1	NA	
Sulfuric acid do	r 12	17	All to Yugoslavia.
Other:			
Oxides of strontium, barium, magnesium	975	475	Sweden 300; Finland 175.
Unspecified	8,886	6,255	All to United Kingdom.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black [2]	8,000	8,400	U.S.S.R. 1,020.
Coal, brown coal briquets [2] thousand tons	2,551	2,286	West Germany 920; Hungary 554; Czechoslovakia 518.
Coke	3,415	1,899	Sweden 1,312; Austria 587.
Gas (natural or manufactured, unspecified) [2] million cubic feet	1,031	1,303	NA.
Petroleum refinery products:			
Gasoline [2] thousand 42-gallon barrels	5,242	4,110	NA.
Distillate fuel oil [2] do	8,346	7,066	NA.
Residual fuel oil do	1,229	2,017	Denmark 755; Austria 734; Sweden 395.
Lubricants do	58	36	Austria 31; Yugoslavia 5.
Other: Mineral jelly and wax [2] do	492	405	NA.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	3,214	3,428	Switzerland 2,535; France 762.

r Revised. NA Not available.

[1] Unless otherwise specified, data are compiled from the 1974 and 1975 editions of the United Nations World Trade Annual and the 1974 Supplement to the World Trade Annual, Walker and Company, New York, vs. I, II, and III, and from official trade statistics of selected trading partner countries (Bulgaria, Czechoslovakia, Hungary, Poland, Romania, and the U.S.S.R.).

[2] Compiled from Official East German Trade Statistics.

Table 3.—East Germany: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite [2] ——thousand tons	248	265	Hungary 180; Yugoslavia 69.
Alumina, Al_2O_3 content [2]	r 90,450	94,524	NA.
Metal including alloys:			
Unwrought	134,963	160,192	U.S.S.R. 114,454; Yugoslavia 45,638.
Semimanufactures [2]	50,000	45,800	U.S.S.R. 19,300; Poland 257.
Cadmium metal including alloys	166	208	All from U.S.S.R.
Chromium: Chromite, Cr_2O_3 content [2]	44,000	58,300	U.S.S.R. 40,000.
Copper:			
Ore and concentrate	9,276	16,239	Sweden 8,959; Canada 2,775; Ireland 2,660.
Metal including alloys:			
Scrap	451	569	United States 248; Belgium-Luxembourg 196; Netherlands 125.
Unwrought	1,173	502	All from Sweden.
Semimanufactures	414	403	Austria 169; Yugoslavia 68; Sweden 46.
Iron and steel:			
Iron ore, Fe content [2] ——thousand tons	1,802	2,118	Mainly from U.S.S.R.
Scrap [2]	r 3,158	22,565	Poland 19,918; Austria 2,647.
Pig iron [2] ——thousand tons	r 833	782	NA.
Ferroalloys [2] ——do	28	24	NA.
Steel, primary forms ——do	65	31	Japan 14; France 13.
Semimanufactures: [2]			
Bars and rods ——do	718	598	U.S.S.R. 406; Poland 110; Czechoslovakia 62.
Angles, shapes, sections ——do	510	508	U.S.S.R. 333; Romania 9.
Hot- and cold-rolled strip ——do	310	313	Hungary 19; Poland 9.
Light plates and sheets ——do	76	75	NA.
Heavy plates and sheets ——do	520	492	U.S.S.R. 436; West Germany 36.
Pipes ——do	335	333	Hungary 98; Poland 22.
Lead:			
Oxide and hydroxide	717	1,016	All from Austria.
Metal, unwrought and semimanufactures	r 45,408	47,009	All from U.S.S.R.
Magnesium, unwrought, unalloyed	3,964	2,030	Do.
Manganese ore, metallurgical grade ——thousand tons	150	179	Do.
Mercury ——76-pound flasks	4,293	12,125	All from Italy.
Nickel metal, all forms [3]	70	59	All from Sweden.
Platinum, unworked ——value, thousands	$1,190	$84	All from Netherlands.
Silver, unworked or partly worked ——do	$15,896	$10,600	All from United Kingdom.
Tin metal including alloys, unwrought	107	99	United Kingdom 69; Belgium-Luxembourg 30.
Titanium oxide	7,684	13,239	All from Yugoslavia.
Tungsten:			
Ore and concentrate	148	60	Austria 30; Netherlands 30.
Metal	2	6	All from Austria.
Zinc metal including alloys, all forms	46,254	49,998	U.S.S.R. 40,553; Finland 4,601.
Other:			
Ores and concentrates of molybdenum, tantalum, titanium, vanadium, zirconium	883	222	All from Belgium-Luxembourg.
Ash and residues containing nonferrous metals	10,935	11,003	All from Spain.
Metals including alloys, all forms:			
Metalloids ——value, thousands	r $60	$1,022	Netherlands $555; Norway $204; Switzerland $182.
Base metals and alloys, n.e.s	219	482	Japan 365; Italy 85.
NONMETALS			
Abrasives, natural:			
Dust and powder of precious and semi-precious stones, except diamond ——value, thousands	$29	NA	
Grinding wheels and stones	205	144	Austria 84; Sweden 57.
Asbestos [2]	56,318	65,725	U.S.S.R. 54,300; Canada 2,267.
Cement [2]	NA	41,000	All from U.S.S.R.
Clays and clay products:			
Crude clays:			
Bentonite	15,643	16,876	All from Hungary.
Kaolin [2]	28,873	32,128	United Kingdom 19,668; Czechoslovakia 12,061.
Products:			
Nonrefractory	752	NA	
Refractory	6,033	6,370	Yugoslavia 3,364; Sweden 824; France 780.

See footnotes at end of table.

Table 3.—East Germany: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Diamond:			
Industrial ——value, thousands	$960	$1,685	All from Belgium-Luxembourg.
Gem ——do——	$633	$55	Do.
Feldspar and fluorspar	25,339	28,616	Norway 18,270; Sweden 8,679; Finland 1,667.
Fertilizer materials:			
Crude, phosphate rock and apatite concentrates, P_2O_5 content [2] thousand tons	528	510	U.S.S.R. 473.
Manufactured:			
Nitrogenous, N content [2] ——do——	194	112	West Germany 24.
Phosphatic, P_2O_5 content [2] ——do——	67	32	West Germany 21.
Graphite [2]	5,173	5,216	NA.
Gypsum ——thousand tons	NA	233	All from Hungary.
Lime	1,702	1,671	All from Poland.
Magnesite, crude, calcined, and sintered thousand tons	47	52	Mainly from Czechoslovakia.
Mica [2]	2,907	2,250	NA.
Pigments, mineral, including processed iron oxides	70	375	Italy 339; Belgium-Luxembourg 36.
Pyrite ——thousand tons	144	118	All from U.S.S.R.
Quartz and quartzite, natural	519	NA	
Stone, sand and gravel	10,512	14,907	Sweden 10,561; Yugoslavia 4,346.
Sulfur:			
Elemental, all forms [2]	r 146,857	146,000	All from Poland.
Sulfuric acid	56,942	36,218	Mainly from Poland.
Talc and related materials	2,362	1,509	All from Austria.
Other: Slag, dross, similar waste	56,166	48,284	Sweden 45,939; Finland 2,345.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black [2]	r 22,923	23,605	All from U.S.S.R.
Coal:			
Anthracite and bituminous [2] thousand tons	r 4,119	3,964	Do.
Lignite ——do——	5,198	3,434	All from Poland.
Coke [2] ——do——	3,042	2,971	U.S.S.R. 1,076; Poland 851.
Gas, manufactured ——million cubic feet	100,339	113,914	NA.
Petroleum:			
Crude [2] ——thousand 42-gallon barrels	r 120,790	124,928	U.S.S.R. 110,963; Iraq 10,838.
Refinery products:			
Gasoline ——do——	168	NA	
Kerosine ——do——	10	8	All from Yugoslavia.
Distillate fuel oil ——do——	99	5	Do.
Residual fuel oil ——do——	NA	57	All from Denmark.
Lubricants ——do——	1	1	All from France.
Other, coke ——do——	10	NA	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	62,334	63,220	All from U.S.S.R.

r Revised. NA Not available.

[1] Unless otherwise specified, data are compiled from the 1974 and 1975 editions of the United Nations World Trade Annual and the 1974 Supplement to the World Trade Annual, Walker and Company, New York, vs. I, II, and III, and from official trade statistics of selected trading partner countries (Bulgaria, Czechoslovakia, Hungary, Poland, Romania, and the U.S.S.R.).

[2] Compiled from Official East German Trade Statistics.

[3] Excludes quantity from Austria, valued at $94,000 in 1974 and $125,000 in 1975.

COMMODITY REVIEW

METALS

Aluminum.—In 1976, East Germany's domestic aluminum consumption was estimated at 200,000 tons per year, while the output of primary metal remained approximately 70,000 tons. Primary aluminum comes from the Bitterfeld electrochemical combine, with an estimated annual capacity of 65,000 tons, and the Lauta aluminum works, with an annual capacity of 25,000 tons. In 1975, East Germany imported 114,454 tons of aluminum from the U.S.S.R.

In 1976, alumina production reached 44,468 tons and came from East Germany's only alumina plant, located at Lauta, having a capacity of 70,000 tons per year. All of East Germany's bauxite is imported, mainly from Hungary and Yugoslavia.

Cadmium.—Estimated cadmium production in 1976 was 18 tons of metal, while estimated consumption was 450 tons. In 1975, 208 tons of cadmium was imported from the U.S.S.R. East Germany's cadmium is obtained mainly as a byproduct of the smelting of zinc and other nonferrous metals at the VEB Mansfeld Kombinat "Wilhelm Pieck," located at Eisleben, and at the "Elektro" works at Weida, Thuringia.

Copper.—Primary copper production in East Germany has virtually come to a standstill. The deposits at Mansfeld-Eisleben-Hettstedt are almost depleted and the mines were closed in 1974.

The copper mines near Sangerhausen, however, maintained their output during 1976. East Germany does not publish its copper production or import figures, but in 1976 as in the past, most of the copper was imported from the U.S.S.R.

A copper drawing and rolling mill was under construction during 1976 at the copper and silver works in Hettstedt, which is part of the VEB Mansfeld Kombinat. The mill is to be completed in 1979 and was developed jointly with the U.S.S.R. It is to help meet the increasing demand for copper wire in the electrical and cable industry.

Iron and Steel.—In 1976, East Germany produced 6.7 million tons of crude steel (up 4.0%), 2.5 million tons of pig iron (up 2.9%), and 4.6 million tons of steel semimanufactures (up 7.3%). East Germany's iron ore resources are almost depleted and production figures are no longer reported. Production of steel and pig iron is also inadequate to meet domestic demand, making East Germany dependent upon imports for a large share of its requirements for these commodities. About 97% of the iron ore and 40% of the pig iron and rolled steel are imported from the U.S.S.R. In 1977, the U.S.S.R. is to provide East Germany with 630,000 tons of pig iron and 1.1 million tons of rolled steel products.

At yearend 1976, work was being completed on the 30-ton plasma furnace at the Freital high-grade steel works. This furnace, which was developed in Novosibirsk, U.S.S.R., was a joint effort between East Germany and the U.S.S.R. It is to operate at a temperature of 15,000° C for melting high-alloy steels having an extremely low carbon content. Argon gas will be used to stabilize the electric arc and to shield the melting mixture from impurities. Short melting times will be available with this furnace since the arc can reach a maximum temperature of 30,000° C.[4]

Expansion has been progressing at the Wilhelm Florin steelworks located at Hennigsdorf, west of East Berlin. A 200,000-ton-per-year rod mill was commissioned in 1976 and a 175,000-ton-per-year arc furnace has been ordered. The iron ore sintering plant at Eisenhüttenstadt went into operation with a design capacity of 4 million tons of sinter per year. This plant was designed by the Institute of Metallurgical Plants and Factories of Bucharest and was built by Romanian engineers.

To maintain its steel production, East Germany placed emphasis on the reconstruction and completion of rolling mills and steel production plants. During the 1976–80 5-year plan, 3 billion marks are to be spent on modernizing and equipping foundries. East Germany is also placing emphasis on recovering secondary metallurgical raw materials.

[4] Berliner Zeitung (East Berlin). Jan. 15–16, 1977, p. 13.

The total number employed in the iron and steel industry in 1976 was 122,700, an increase of 3,300 over that of 1975.[5] Foundries comprise 450 enterprises and employ approximately 60,000 people.

Lead and Zinc.—Lead and zinc data are not reported by East Germany, and primary production is assumed to have declined to insignificance owing to depletion of ore reserves. Secondary lead and zinc production in 1976 was estimated at 36,000 tons and 18,000 tons, respectively. Estimated consumption was 85,000 tons for lead and 62,000 tons for zinc. In 1975, East Germany imported 47,009 tons of lead and 40,553 tons of zinc from the U.S.S.R.

East Germany's indigenous resources of lead and zinc consist of low-grade complex polymetallic ores that contain lead, zinc, silver, pyrites, and fluorspar in thin beds mined in the vicinity of Freiberg. The ores are concentrated by flotation at two plants at Freiberg.

Nickel.—Estimated nickel production in 1976 was 2,500 tons, compared with 2,400 tons in 1975. Nickel production had been rising in the past few years owing to modernization of the nickel industry which is centered at the Aue (St. Egidien) nickel plant.

Tin.—Tin production for 1976 was estimated at 1,200 tons, unchanged from that of 1975. Tin production is to increase 43% to 45% during the present 5-year plan by renovating and expanding existing mining and ore-processing capacities. The first stage of the Albert Funk smelting combine at Freiberg was put into operation during 1976. It is now processing the low-grade ores of the large tin ore deposit near Altenberg.

East Germany's tin deposits are located in the Erzgebirge along the southeastern border of the country, with mines at Altenberg, Sadisdorf, and Ehrenfriedersdorf. The ore contains 0.2% to 0.35% tin and is beneficiated by gravity concentration to approximately 40%.

NONMETALS

Barite.—Barite production in 1976 was estimated at 31,000 tons, as in the past few years, providing for domestic demand and leaving about one-third for export. Barite is processed at the Lengenfeld fluorite and barite plant in the south of the country.

Cement.—Production of cement in 1976 reached 11.3 million tons, a 6.4% increase over that of 1975. East Germany has 11 cement plants dispersed throughout the country. The largest plant is the Karsdorf cement works near Halle with an annual production of 4.3 million tons. The Deuna cement works near Erfurt is being expanded and is to reach a 2.5-million-ton-per-year capacity in the near future.

East Germany's cement production is to be increased 25% by 1980 through the better utilization and expansion of existing facilities. Geological exploration for cement raw materials is being continued in the Posewald area and is to be completed by yearend 1977.

Chalk.—Chalk production for 1976 was estimated at 50,000 tons. Europe's largest compact chalk deposits are located on East Germany's Rügen Island near Sassnitz. The deposits are being strip mined in the Wittenfelde chalk quarry on the Jasmund Peninsula, and are so vast that they will be able to supply the country's demands for many years.[6] Presently, about 400 enterprises in East Germany are obtaining chalk from Rügen Island, which is being used in making numerous products. About one-fourth of the annual chalk production is exported.

Clays.—East Germany is planning an annual increase of 5% to 6% in the production of clays during the 1976–80 period. To insure this output, the opening of new deposit sites of white burning clay is planned at Rossbach in the Halle District, of fireproof clay at Guttau in the Cottbus District, and of vitreous sand at Hohenbocka, also in the Cottbus District. High-quality kaolin is to be provided by the opening of a new kaolin works at Cominau in 1977 and by additional construction projects at the works in Salzmünde, Spergau, and Kemmlitz.[7] The kaolin deposit situated near Bautzen is the richest in East Germany.

Fertilizer Materials.—East Germany's total fertilizer production in 1976 reached 4.4 million tons of nutrients (nitrogen,

[5] United Nations. The Steel Market in 1976. ECE Report. Steel/WP.1/R.5/Add. 5, Apr. 4, 1977, pp. 1–2.
[6] IWE Tagesdienst (Bonn). Feb. 1, 1977, p. 2.
[7] Presse-Informationen (East Berlin). Dec. 14, 1976, p. 6.

P_2O_5, and K_2O content). Potassic fertilizers constituted 72% of the total, nitrogenous fertilizers 18%, and phosphatic fertilizers 10%.

Nitrogen.—Production of nitrogenous fertilizers in 1976 reached a total of 776,000 tons (nitrogen content), an increase of 44.2% over that of 1975. Production is centered around Leipzig in the south, with one important plant located at Schwedt near the Polish border. The increase in production is mainly owing to the full operation of three new units of the VEB Stickstoffwerk Piesteritz, including a 345,000-ton-per-year nitrogenous fertilizer and plastics-grade urea plant constructed by Czechoslovakia, a 450,000-ton-per-year ammonia plant designed by M. W. Kellog Co. and constructed by Toyo Engineering Corporation, and a 350,000-ton-per-year urea plant. An estimated 80% to 90% of the urea produced at these new plants is used for fertilizer purposes.[8] East German nitrogenous fertilizer imports in 1975 amounted to 111,800 tons.

Phosphate.—East Germany has virtually no phosphatic raw materials and therefore must import phosphate. In 1975, East Germany imported a total of 509,700 tons (P_2O_5 content) of raw phosphate and apatite concentrates and 32,300 tons of phosphatic fertilizers, most of which came from the U.S.S.R. East Germany's production of phosphatic fertilizers in 1976 was 423,000 tons (P_2O_5 content).

Potash.—In 1976, East Germany remained the world's third largest producer of potash, with 13% of total world output. Production reached 3.2 million tons, a 4.7% increase over that of 1975.

Exports of potash in 1975 totaled 2.25 million tons, of which 1.44 million tons went to CMEA countries and 483,000 tons went to Western Europe. In 1976, exports of potash totaled 2.43 million tons.

East Germany went through a period of improving the potash industry in the early 1970's by closing down smaller submarginal mines, commissioning new capacities, and upgrading the quality of the product. These improvements have enabled East Germany to increase production of potash despite the closing of several mines. A major event was the commissioning of the potash mine and refinery of Kalibetrieb Zielitz, about 10 kilometers north of Magdeburg. The refinery, which is to reach a capacity of 900,000 tons of K_2O per year when in full operation, has four lines of flotation cells that yield a standard-grade potassium chloride (minimum 60% K_2O) as the principal product. The commissioning of the mine more than replaced the capacity lost by the closing of the Saale group of mines.[9]

East Germany's potash industry was restructured in 1970 when the VEB Kombinat Kali was formed. The industry is now divided into four groups, each responsible for several mines. The Kalibetrieb Werra controls the mines at Unterbreizbach, Merkers, and Dorndorf in the southwestern part of the country. The Kalibetrieb Süd Harz is responsible for the operations of six mines at Rossleben, Sondershausen, Sollstedt, Bleicherode, Menteroda, and Bischofferode, all in the Harz region. The Kali und Steinsalzbetrieb Saale consisted of only one potash mine at Teutschenthal. The Kalibetrieb Zielitz operates East Germany's newest mine at Zielitz.[10]

Sulfur.—*Sulfuric Acid.*—Sulfuric acid production in 1976 was 957,000 tons. This production should increase as soon as the newly built plants at Magdeburg, Seelingstädt, and Nünchritz go into full operation.

MINERAL FUELS

In 1976, East Germany produced 247 million tons of lignite, 550,000 tons of bituminous coal, 8.0 billion cubic meters of natural gas, and 350,000 tons of crude oil. During the same year, it imported 18.0 million tons of crude oil, 4.0 billion cubic meters of natural gas, 6.1 million tons of bituminous coal, and 2.9 million tons of coke. Exports amounted to 2.3 million tons of brown coal briquets and approximately 3.0 million tons of petroleum products. In 1980, East Germany expects to maintain its lignite, natural gas, and crude oil production at approximately the 1976 levels. Indigenous bituminous coal is expected to be depleted before 1980, and imports of natural gas and crude oil are to increase considerably.

East Germany produced a total of 89.2 billion kilowatt-hours of electric energy in

[8] Nitrogen (London). No. 100, March/April 1976, p. 15.
[9] Phosphorus and Potassium (London). No. 87, January/February 1977, pp. 40–43.
[10] Page 41 of work cited in footnote 9.

1976; by 1980 this figure is to reach 104 billion to 109 billion kilowatt-hours. More than 80% of the electric power presently produced is from lignite. Domestic lignite will continue to be the primary energy source; its share in 1980 is expected to be approximately 60%. Electric energy produced by nuclear powerplants in 1976 totaled 7.5 billion kilowatt-hours or 8.4% of the total electric energy produced.

East Germany's total primary energy consumption for 1976 reached an estimated 121.7 million tons of standard coal equivalent, representing an increase of 1.8% over that of 1975. Coal provided 67.2% of the total primary energy, oil 18.7%, natural gas 13.1%, nuclear energy 0.7%, hydroelectric energy 0.2%, and imported electric energy 0.1%.

The production of primary energy derived from domestic fossil fuels, nuclear energy, and hydroelectricity generation in 1976 remained the same as in 1975 at 86.8 million tons of standard coal equivalent. This domestic production represented 71.3% of total primary energy consumption, while imports of primary energy made up 33.4%. The total primary energy balances for 1975 and 1976 are shown in table 4.

Coal.—In 1976, East Germany produced 247 million tons of lignite and 550,000 tons of bituminous coal. The lignite production represented 28% of total world output, making East Germany again the world's top producer. East Germany utilizes more than 40% of its lignite for making fuel briquets, whose production in 1976 reached 48.7 million tons.

In 1976, East Germany imported a total of 6.1 million tons of bituminous coal, of which 4.1 million tons came from the U.S.S.R., 1.3 million tons from Poland, 593,000 tons from Czechoslovakia, and 148,000 tons from West Germany. Coke imports for the same year totaled 2.9 million tons, of which 1.1 million tons came from the U.S.S.R., 751,400 tons from Czechoslovakia, 775,000 tons from Poland, and 204,000 tons from West Germany. Brown coal briquet exports amounted to 2.3 million tons in 1976, continuing the decreasing trend from 6.3 million tons in 1960 and 3.8 million tons in 1970. These exports are primarily to Hungary, Czechoslovakia, West Germany, and Austria.

Lignite is now being mined at 36 surface mines with an output of nearly 700,000 tons per day. The Cottbus region is the principal mining area and produces approximately 50% of the country's total production. This region has the largest and the most productive surface mines, which employ modern large-capacity surface mining equipment. The rest of the lignite mining is done at 20 surface mines in the coal regions of Halle and Leipzig.

Future lignite mining in East Germany will be increasingly difficult owing to unfavorable geological and hydrological con-

Table 4.—East Germany: Primary energy balance for 1975 and 1976

(Million tons of standard coal equivalent [1])

Year	Total primary energy	Coal (lignite, brown, bituminous)	Crude oil and petroleum products	Natural and associated gas	Hydroelectric power	Nuclear power	Electric power
1975:							
Production [2]	86.8	74.6	0.5	10.6	0.2	0.9	--
Imports	38.8	9.1	25.2	4.3	--	--	0.2
Exports	6.0	1.5	4.4	--	--	--	.1
Apparent consumption	119.6	82.2	21.3	14.9	.2	.9	.1
1976:							
Production [2]	86.8	74.6	.5	10.6	.2	.9	--
Imports	40.7	8.7	26.5	5.3	--	--	.2
Exports	5.8	1.5	4.2	--	--	--	.1
Apparent consumption	121.7	81.8	22.8	15.9	.2	.9	.1

[1] 1 ton standard coal equivalent (SCE)=7,000,000 kilocalories. Conversion factors used are: Hard coal, 1.0; lignite and brown coal, 0.3; crude oil, 1.47; natural gas, 1.33 (per thousand cubic meters); and hydroelectric and nuclear power, 0.125 (per thousand kilowatt-hours).

[2] Derived from table 1.

Source: United Nations. World Energy Supplies, Statistical Papers. New York. Ser. J, No. 18, 1975.

ditions. A greater amount of overburden will have to be removed to obtain the same amount of lignite. Ratios of cubic meters of overburden to tons of lignite for the coming years will probably develop as follows:[11] 1960, 2.8:1; 1975, 3.9:1; 1980, 4.5:1; 1985, 4.8:1; and 1990, 5.2:1.

With these more costly mining conditions, the required increase in annual production of 250 million to 254 million tons by 1980 can only be reached by intensification of mining at existing surface mines, fuller mechanization, development of 18 new large open pits in the Halle-Leipzig area and south of Cottbus, and closing down unprofitable mines. By 1980, 76% of the overburden is to be removed by continuous systems including overburden conveyor bridges and belt conveying systems. The percentage is to reach 85% in 1985.

East Germany's total geological resources of lignite as of January 1, 1971, amounted to approximately 38 billion tons. The industrial reserves which can be economically mined and processed with present-day technology amounted to about 26 billion tons. The industrial reserves with an overburden-to-coal ratio of less than 10:1 amounted to 20 billion tons.[12]

The present industrial reserves are located in 144 coalfields. Approximately 45% of all the reserves are found in 23 fields that have resources of more than 250 million tons. Of the remaining 121 fields, 77 have reserves of less than 100 million tons. East German lignite is a lower-rank fuel, possessing a calorific value of approximately one-third that of standard bituminous coal (ranging from 1,800 to 2,700 kilocalories per kilogram or 2,300 to 4,800 Btu per pound). The moisture content ranges from 45% to 56% for the Magdeburg deposits and 52% to 62% for the Lausitz deposits, around Cottbus and Senftenberg. The ash content ranges from 6% to 13%.[13]

East Germany presently uses domestic lignite to produce 80% of its electric power. Lignite will continue to be East Germany's primary energy source; its share of energy production in 1980 is to be approximately 60%.

The surface mines at Jänschwalde and Cottbus-Nord are being developed to supply the Jänschwalde powerplant which will have a capacity of 3,000 megawatts. The Jänschwalde surface mine started producing lignite in 1976 and is to become the largest mine in the future. It will have a 60-meter overburden conveyor bridge that is to begin operating in mid-1978. The mine should then reach design capacity of nearly 20 million tons of lignite per year. The Cottbus-Nord open pit is to produce 15 million tons per year in 1981.[14]

Two other surface mines are to be developed, the Bärwalde and Schlabendorf open pits in the Lausitz region. Reconstruction of the Greifenhain surface mine is to insure a fourfold increase in production in the future. By 1980, newly opened surface mines are to replace depleted annual capacity of 78 million tons and add 35 million tons of new annual capacity.

An institute for lignite mining was established in 1976 at the mining town of Grossräschen, in the Cottbus District. The new facility was evolved from the Brown Coal Rationalization VEB, which ceased operations at yearend 1976. The new institute is to serve as the scientific center for coordination of research, development, and rationalization of lignite mining in East Germany.[15]

Natural Gas.—Natural gas production reached a stable level of approximately 8 billion cubic meters for the past 3 years. Considerable effort is to be exerted to maintain this output in the near future. Recent natural gas production continued to come mostly from the Salzwedel gasfields, located in the Magdeburg District near the West German border, that were discovered in 1971. Before the discovery of these gasfields, natural gas production was around 100 million cubic meters per year and came from a few small gasfields located near Erfurt, Cottbus, and Rostock. In 1970, annual production increased to approximately 400 million cubic meters and then climbed to 2.8 billion in 1971,

[11] Baumgart, Günter. Raw Materials Are a Problem for Us Too. Neuer Tag (Frankfurt/Oder). March 1976, p. 6.

[12] Strozodka, Klaus, and Günter Piske. Die Entwicklung des Braunkohlenbergbaus in der D.D.R. (The Development of Brown Coal Mining in East Germany). Neue Bergbautechnik (Leipzig). V. 6, No. 10, October 1976, pp. 737–741.

[13] Glückauf (Essen). V. 108, No. 23, Nov. 9, 1972, pp. 1090–1095.

[14] Bönicke, Hans Jürgen. New Power Plants—New Strip Mining, Coal Mining and Energy Production Closely Connected. Berliner Zeitung (East Berlin). June 15, 1977. p. 3.

[15] Berliner Zeitung (East Berlin). Jan. 4, 1977, p. 2.

5.2 billion in 1972, 7.0 billion in 1973, and is now leveling off at about 8.0 billion. East Germany is still searching for commercial-size reserves by deep drilling in other parts of the country. Present natural gas reserves are estimated at about 100 billion cubic meters.

East Germany imported approximately 3 billion cubic meters of natural gas from the U.S.S.R. in 1975 and about 4 billion cubic meters in 1976, and plans to import 7 billion cubic meters in 1980.

With the other CMEA countries, East Germany is participating in the construction of the Orenburg gas pipeline which is to link the large deposits of natural gas in Orenburg, in the southern Ural Mountains of the U.S.S.R., to the borders of Eastern Europe. East Germany is responsible for a 550-kilometer section of this pipeline that lies in the Ukraine and runs from Kremenchug on the Dnieper River to the town of Bar. This section is to cross several rivers, 10 railroad lines, and 15 main roads. The most difficult task is laying the line across the Dnieper River which is 1,500 meters wide at the crossing point. Upon completion by 1980, this pipeline is to supply Eastern European countries with 15.5 billion cubic meters of natural gas per year. Each of the CMEA countries involved in the construction will receive deliveries of gas for a period of 12 years as payment for participation in the construction of the pipeline.

Petroleum.—Domestic crude oil production remained insignificant with approximately 350,000 tons produced in 1976. A total of 18.0 million tons of crude oil was imported during the year, representing 98% of total crude oil requirements. The U.S.S.R. provided 16.0 million tons, while 2.0 million tons came from Persian Gulf countries. By 1980, oil imports from the U.S.S.R. and Persian Gulf countries are to increase to 19.5 million tons and 3.0 million tons, respectively. The Soviet crude is delivered from Almeteevsk to East Germany through the Friendship oil pipeline. In 1976, East Germany exported an estimated 2.7 million tons of petroleum products.

East Germany's refining capacity reached 18 million tons per year in 1976 and is to increase to 22.5 million to 23 million tons by 1980. Crude petroleum is processed at Schwedt, Böhlen, Zeitz, Lützkendorf, and Leuna. The Schwedt refinery is to be expanded to process 12 million tons of Soviet oil annually by 1980, compared with 9.3 million tons in 1976. The crude oil processing capacity at Leuna is to be raised 7% during the 1976–80 5-year plan.

In spite of considerable efforts to develop domestic oil reserves, East Germany has, so far, discovered only small deposits along the seaboard. Plans have been made for offshore drilling in the Baltic Sea in cooperation with Poland and the U.S.S.R.

Nuclear Power.—In 1976, East Germany produced approximately 7.5 billion kilowatt-hours of electric energy through the use of nuclear powerplants, representing 8.4% of the total electric energy produced in 1976. By 1980, nuclear power is to provide 17.0 billion kilowatt-hours. At present, East Germany has two operating nuclear powerplants. The Rheinsberg powerplant, located approximately 100 kilometers north of East Berlin, has been in operation since 1966 and has a capacity of 70 megawatts. The Bruno Leuschner North powerplant, near Greifswald, has been operating its first 440-megawatt reactor block since 1973 and its second 440-megawatt block since mid-1975. The second stage of this powerplant is presently under construction and is comprised of three 440-megawatt blocks similar to the ones now in operation. Further expansion of the powerplant is to add three 440-megawatt blocks to make a total capacity of 3,520 megawatts. A third nuclear powerplant is in the planning stage and is to be located at Stendal, near Magdeburg. This plant is eventually to consist of eight 440-megawatt reactor blocks, similar to the Bruno Leuschner North plant.[16]

The nuclear powerplants in East Germany, as in other CMEA countries, are being built in very close cooperation with the U.S.S.R., which provides much of the equipment and technology.

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[16] Nawrocki, Joachim. Nuclear Powerplants, Energy Situation Surveyed. Die Zeit (Hamburg). May 27, 1977, p. 27.

The Mineral Industry of the Federal Republic of Germany

By Joseph B. Huvos [1]

In 1976, West Germany was one of the world's major processors and consumers of minerals, most of which were imported. There was, however, a plentiful supply of domestic coal, potash, and salt. The most important mineral products of the country were lignite (15% of the world total), bituminous coal (5%), potash (8%), crude steel (6%), refined copper (6%), smelter zinc (6%), aluminum ingot (6%), barite (5%), and smelter lead (3%).

In 1976, the gross national product (GNP) of the Federal Republic of Germany was $446 billion.[2 3] The contribution of the minerals industry to the total was about 10%; the contributions of the individual branches of the minerals industry in 1975 and 1976 are shown in table 1.

Although the overall economy of West Germany made a fairly good recovery in 1976, mining lost ground on a per-ton

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted to U.S. dollars from Deutsche marks (Dm) at the rate of Dm2.518=US$1.00 for 1976 (International Monetary Fund).

[3] U.S. Department of State. Foreign Economic Trends and Their Implications for the United States. Federal Republic of Germany. June 1977, p. 2.

Table 1.—Federal Republic of Germany: Contribution to gross product and employment by the mineral industry

	Contribution to gross product [1] (million dollars)		Percent change	Average 1976 employment (thousand persons)
	1975	1976		
MINING				
Iron ore	59	43	−27.1	2
Nonferrous metals	59	57	−3.4	2
Potash and salt	449	479	6.7	12
Other nonmetallic minerals	21	24	14.3	1
Coal	4,885	5,143	5.3	199
Lignite	469	598	27.5	20
Peat	86	83	−3.5	4
Oil and gas	1,109	1,282	15.6	7
Total	7,137	7,709	8.0	247
PROCESSING				
Iron and steel	r 15,878	16,053	1.1	302
Nonferrous metals	4,374	5,428	24.1	80
Stone and earths	7,614	7,935	4.2	185
Petroleum refining	12,477	14,201	13.8	30
Total	r 40,343	43,617	8.1	597

r Revised.

[1] Includes production outside the territory of the Federal Republic of Germany; does not include value-added tax.

Source: Adapted from Statistisches Bundesamt, Wiesbaden. Wirtschaft und Statistik. V. 17, No. 3, 1977, pp. 151*, 152*.

basis, as bituminous coal output fell slightly.

There were no major new capital investments in West Germany's mineral industry. One thermal and one electrolytic zinc plant expanded their facilities. One aluminum smelter changed hands, one lead-zinc mine was closed, and a coal-fired powerplant came onstream. An extensive domestic and foreign exploration program was pursued for securing West Germany's minerals supply.

PRODUCTION

In 1976, production was still under the influence of sluggish market conditions, after the previous year's slump. Production of mineral commodities is shown in table 2, and the following tabulation shows the major producers of mineral commodities in 1976:

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	Vereinigte Aluminium-Werke AG (VAW), plants at Norf, Stade, Lünen, Töging, and Grevenbroich, Government	47
Do	Reynolds Aluminium Hamburg GmbH, smelter at Hamburg, Reynolds International Inc. 90%, city government 10%	13
Do	Aluminium-Hütte Rheinfelden GmbH, plants at Rheinfelden, Essen, and Borbeck, Alusuisse	8
Coal	Ruhrkohle AG, mines in Ruhr Basin, VEBA AG 14%, Gelsenberg AG 13%, Salzgitter AG 11%, Sidéchar, France, 8%, and Hoesch AG 8%	76
Do	Eschweiler Bergwerks Verein, mines in Aachen area, Arbed, Luxembourg	8
Do	Saarbergwerke AG, mines in Saar Basin, Government	10
Copper, refined	Norddeutsche Affinerie, refinery at Hamburg, Degussa 40%, Metallgesellschaft AG 40%, and British Metal Corp. Ltd. 20%	80
Ferroalloys	Gesellschaft für Elektrometallurgie mbH, plants at Nürnberg and Eschweiler-Weisweiler, Metallurg Inc., United States	40
Do	Thyssen-Hütte AG, plant at Duisburg-Hamborn	30
Iron and steel	Thyssen-Hütte AG, plants at Duisburg, Bruckhausen, Beeckerwerth and Ruhrort	24
Do	Stahlwerke Peine-Salzgitter AG, mines and plant at Salzgitter, Government	12
Do	Mannesmann AG, plant at Duisburg-Huckingen	10
Do	Fried. Krupp Hüttenwerke AG, plant at Bochum	9
Lead and zinc	Preussag AG Metall, mines at Lüderich, Meggen and Rammelsberg, smelters at Nordenham and Harlingerode, Government	50
Do	Sachtleben Bergbau GmbH, mine and smelter at Lennestadt-Meggen, Metallgesellschaft	38
Do	AG des Altenbergs für Bergbau und Zinkhüttenbetrieb, mine at Lüderich, Vieille Montagne, Belgium	12
Lignite	Rheinische Braunkohlenwerke AG, Aachen-Cologne Basin mines, Rheinisch Westfälisches Elektrizitätswerk AG 100%	76
Petroleum and natural gas.	Shell-Esso-Mobil, fields north of Elbe, Elbe-Wesser, Weser-Ems, Ems Estuary, west of Ems, Upper Rhine Valley, and South Bavaria	54
Do	Gelsenberg AG, Preussag AG, and Salzgitter AG, fields north of Elbe, Elbe-Wesser, Weser-Ems, Ems Estuary, west of Ems, Upper Rhine Valley, South Bavaria	23
Petroleum, refined products.	VEBA AG, refineries at Gelsenkirchen, Salzbergen, and Lingen, Government	44
Do	Deutsche BP AG, refineries at Hamburg, Bucholdtwelmen, and Vottburg, BP	12
Do	Esso AG, refineries at Hamburg, Köln, Karlsruhe, and Ingolstadt, Esso	12
Do	Deutsche Shell AG, refineries at Hamburg, Monheim, Godorf, and Ingolstadt, Shell	10
Potash	Kali und Salz AG, mines at Salzdetfurth, Sigmundshall, and Wintershall, BASF AG 73%	89
Do	Kali-Chemie AG, mine at Friedrichshall, Solvay, Belgium	11
Rare metals	Deutsche Gold und Silberscheideanstalt, (Degussa) refinery at Hamburg	80

Table 2.—Federal Republic of Germany: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum:			
Bauxite, gross weight	1,407	755	221
Alumina ---thousand tons	1,307	1,246	1,333
Metal:			
Primary ---do	689	678	697
Secondary:			
Unalloyed ---do	47	38	42
Alloyed ---do	280	250	305
Bismuth:			
Ore and concentrate e	10	11	11
Metal, smelter e	450	600	500
Cadmium, smelter	1,338	1,018	1,275
Cobalt, smelter	356	340	e 350
Copper:			
Mine output, metal content	1,734	1,961	1,613
Metal:			
Blister and anodes:			
Primary	174,029	168,125	193,695
Secondary	70,642	47,722	50,805
Refined including secondary:			
Electrolytic	313,152	318,916	334,150
Fire, refined	110,409	103,286	112,431
Gold:			
Mine output, metal content ---troy ounces	1,315	2,116	2,456
Metal including secondary ---do	313,437	351,471	346,842
Iron and steel:			
Iron ore and concentrate ---thousand tons	4,439	3,288	2,256
Pig iron and blast furnace ferroalloys ---do	40,221	30,074	31,849
Electric furnace ferroalloys ---do	283	257	240
Steel ingots and castings ---do	53,232	40,415	42,415
Semimanufactures ---do	38,858	28,873	29,793
Lead:			
Mine output, metal content	30,673	32,383	31,675
Metal, unalloyed:			
Primary	116,130	92,242	100,965
Secondary	205,272	167,924	177,340
Magnesium metal and alloys:			
Unwrought (secondary only) e	1,700	800	500
Castings	23,756	16,335	18,173
Mercury (secondary) e ---76-pound flasks	7,300	6,700	5,800
Molybdenum metal	186	179	227
Nickel including secondary 1	146	122	130
Platinum ---troy ounces	4,115	3,601	2,283
Silver:			
Mine output, metal content ---thousand troy ounces	1,235	1,079	1,026
Metal including secondary ---do	23,586	20,417	23,497
Tin metal including secondary	2,528	2,332	2,254
Tungsten metal	1,513	894	1,563
Zinc:			
Mine output, metal content	116,622	116,072	115,344
Metal, unwrought, unalloyed, primary	r 400,049	294,725	304,754
NONMETALS			
Barite	306,395	254,902	276,779
Bromine, fluorine, iodine	r 5,253	4,270	4,154
Cement, hydraulic ---thousand tons	35,977	33,516	34,134
Chalk ---do	259	--	--
Clays:			
Fire clay (exclusive of klebsand) ---do	5,218	4,525	5,056
Kaolin (marketable) ---do	496	419	442
Bleaching ---do	723	599	628
Other (schieferton) ---do	89	90	108
Corundum, artificial ---do	101	81	83
Diatomite and similar earth (marketable)	47,743	54,630	52,948
Feldspar (marketable)	374,844	395,833	419,976
Fertilizers:			
Crude:			
Phosphate rock ---thousand tons	85	81	86
Potassic:			
Gross weight ---do	26,202	22,006	21,177
K_2O equivalent ---do	3,090	2,607	2,441
Manufactured:			
Nitrogenous (nitrogen content):			
Nitrogenous fertilizers ---do	1,104	1,065	925
Mixed fertilizers ---do	460	387	322
Total ---do	1,564	1,452	1,247

See footnotes at end of table.

Table 2.—Federal Republic of Germany: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS—Continued			
Fertilizer—Continued			
Manufactured—Continued			
Phosphatic (P_2O_5 content):			
Superphosphate ---thousand tons--	60	43	40
Thomas slag fertilizers ---do---	242	185	167
Other phosphatic fertilizers ---do---	205	152	174
Mixed fertilizers, gross weight ---do---	448	378	317
Total ---do---	955	758	698
Potassic K_2O equivalent:			
Marketable crude ---do---	58	60	70
Chemically processed ---do---	2,562	2,163	1,966
Total ---do---	2,620	2,223	2,036
Content of mixed fertilizers [2] ---do---	488	404	392
Mixed fertilizers, gross weight ---do---	3,214	2,673	2,356
Fluorspar (marketable):			
Acid grade [e]	r 60,706	r 67,178	57,789
Metallurgical grade [e]	r 7,412	r 7,464	6,421
Total	r 74,118	74,642	64,210
Graphite:			
Crude	19,350	23,546	19,101
Marketable [3]	16,485	13,557	14,026
Gypsum and anhydrite, marketable ---thousand tons--	2,302	2,084	2,100
Lime, quicklime and hydrated lime, including dead-burned dolomite ---do---	11,211	9,175	9,623
Pigments, natural mineral ---do---	18	18	23
Pumice:			
Crude and washed ---do---	4,822	3,584	3,755
Marketable ---do---	2,101	1,915	2,316
Pyrite (marketable concentrate):			
Gross weight ---do---	477	492	523
Sulfur content ---do---	214	221	233
Quartz, quartzite, glass sand:			
Quartzite ---do---	320	384	372
Quartz sand ---do---	473	402	423
Quartz sand (unground) and glass sand ---do---	7,301	5,669	6,171
Salt (marketable):			
Rock ---do---	6,982	5,379	6,375
Marine and other ---do---	4,338	3,937	4,942
Stone, sand and gravel, n.e.s.:			
Dimension stone ---thousand cubic meters--	242	210	218
Limestone, industrial ---thousand tons--	59,144	52,574	54,628
Crushed and broken ---do---	124,376	113,115	105,689
Slate [4] ---do---	11	NA	2
Basalt lava and lava sand ---do---	6,597	6,894	5,922
Calcite ---do---	22	7	4
Grinding stone ---cubic meters--	59	NA	NA
Tuff ---thousand tons--	2	3	3
Industrial sands:			
Molding sand ---do---	1,155	1,007	1,002
Other (klebsand) ---do---	197	140	143
Sand and gravel ---do---	183,946	171,476	163,359
Sulfur, elemental byproduct ---do---	429	521	608
Talc including talc schist ---do---	30	21	18
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	299,668	260,992	292,322
Coal:			
Anthracite ---thousand tons--	7,384	7,651	6,628
Bituminous ---do---	87,492	87,742	82,641
Lignite ---do---	126,044	123,377	134,535
Total ---do---	220,920	218,770	223,804
Coke:			
Metallurgical ---do---	r 34,921	34,818	31,951
Gas house ---do---	1,544	1,250	971
Total ---do---	r 36,465	36,068	32,922
Fuel briquets:			
Anthracite and bituminous ---do---	2,249	1,697	1,358
Lignite ---do---	6,326	4,984	4,391

See footnotes at end of table.

Table 2.—Federal Republic of Germany: Production of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
MINERAL FUELS AND RELATED MATERIALS—Continued			
Gas:			
Manufactured gas (excluding that from petroleum refineries):			
Blast furnace gas ---million cubic feet--	r 278,879	201,292	201,434
Coke oven gas [5] ---do----	r 287,919	288,414	263,517
Other gas ---do----	r 79,705	74,655	72,359
Total ---do----	r 646,503	564,361	537,310
Natural:			
Gross production ---do----	734,787	645,445	665,537
Marketable production ---do----	713,202	639,414	658,050
Peat:			
Agricultural use ---thousand tons--	1,871	1,950	1,904
Fuel use ---do----	187	226	238
Petroleum:			
Crude ---thousand 42-gallon barrels--	44,718	41,470	39,902
Refinery products:			
Gasoline, aviation and motor fuel ---do----	163,944	115,378	147,439
Jet fuel ---do----	12,365	11,789	10,799
Kerosine ---do----	529	257	378
Distillate fuel oil ---do----	307,810	269,543	301,929
Residual fuel oil ---do----	210,135	144,088	158,397
Lubricants ---do----	8,787	8,444	9,081
Other:			
Liquefied petroleum gas ---do----	32,511	26,498	32,680
Bitumen ---do----	27,479	24,274	23,063
Unspecified ---do----	45,772	90,132	98,534
Refinery fuel and losses ---do----	40,185	35,762	38,230
Total ---do----	849,517	726,165	820,530

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Primary nickel and nickel contained in ferronickel, Monel metal, and nickel oxide directly used by the steel industry.

[2] K_2O equivalent of potassic constituent not added to K_2O equivalent of marketable crude and chemically processed potassic fertilizers because this would result in double counting.

[3] Produced in part from imported crude graphite.

[4] Exclusive of slate recovered from mine dumps.

[5] Includes water gas and generator gas from coke ovens.

TRADE

In 1976, West Germany traded with most countries of the world (151), although the countries of the European Economic Community (EEC) were its principal trading partners. The country's 1976 trade balance was favorable, but the surplus was expected to disappear almost completely by 1977. Mineral commodities exported included petrochemicals, petroleum products, iron, steel, semifinished steel products, nonferrous metals, and semifinished products. Principal mineral imports consisted of crude oil, natural gas, petroleum products, nonferrous metals, iron and steel, iron ore, and crude minerals. West German trade in 1974 and 1975 is shown in tables 3 and 4.

Table 3.—Federal Republic of Germany: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite	1,255	10,178	Republic of South Africa 4,035; Belgium-Luxembourg 3,616.
Alumina	245,379	227,639	Canada 45,497; Netherlands 32,095.
Aluminum hydroxide	123,398	111,172	Sweden 45,554; Netherlands 21,365.
Metal including alloys:			
Scrap	31,756	27,711	Netherlands 12,402; Italy 7,838; France 6,251.
Unwrought	174,309	159,658	France 42,751; Netherlands 28,114; Belgium-Luxembourg 22,578; Italy 17,753.
Semimanufactures	278,173	195,538	France 43,671; Netherlands 27,518; Belgium-Luxembourg 23,752; Norway 13,901.
Antimony:			
Ore and concentrate	55	7	NA.
Metals including alloys, all forms	196	111	Belgium-Luxembourg 45; Netherlands 40.
Arsenic hydroxide and acids	295	609	Italy 246.
Beryllium metal including alloys, all forms kilograms	(1)	8	Mainly to Czechoslovakia.
Bismuth metal including alloys, all forms	274	401	United Kingdom 84; United States 50.
Cadmium metal (including rhenium), including alloys, all forms	237	408	United States 20; Netherlands 10.
Chromium:			
Chromite	3,679	3,014	Mainly to Austria.
Oxide and hydroxide	10,558	7,147	NA.
Metal including alloys, all forms	331	106	Italy 56; Belgium-Luxembourg 36.
Cobalt:			
Oxide and hydroxide	56	NA	
Metal including alloys, all forms	286	222	Austria 45; Sweden 34; Belgium-Luxembourg 22.
Columbium and tantalum metal including alloys, all forms:			
Columbium kilograms	11,959	15,858	Mainly to Belgium-Luxembourg.
Tantalum do	59,281	29,331	Mainly to France.
Copper:			
Ore and concentrate	5,015	NA	
Matte	NA	1,182	All to Belgium-Luxembourg.
Copper sulfate	1,541	270	NA.
Metal including alloys:			
Scrap	41,790	28,493	Italy 10,194; Austria 5,221; Netherlands 3,835; Belgium-Luxembourg 3,423.
Unwrought:			
Blister	50,222	38,463	United Kingdom 20,743; Belgium-Luxembourg 16,520.
Refined	82,440	49,790	Austria 8,541; Netherlands 7,775; Switzerland 7,063; France 6,999.
Alloys	7,415	6,597	Italy 1,677; Austria 873; Netherlands 842; Sweden 755.
Master alloys	1,024	724	France 605; Belgium-Luxembourg 75.
Semimanufactures	224,827	169,519	France 23,211; Netherlands 22,726; Belgium-Luxembourg 12,412.
Gallium metal including alloys kilograms	NA	97	Switzerland 65; Netherlands 15.
Germanium metal including alloys, all forms value	$143,524	$89,981	France $43,741.
Gold:			
Ash and waste kilograms	(2)	198	NA.
Scrap and sweepings thousand troy ounces	(3)	36	All to Hungary.
Metal:			
Unwrought do	288	493	Switzerland 141; Israel 117; Singapore 55.
Semimanufactures do	7,858	178	United Kingdom 54; Italy 22.
Iron and steel:			
Ore and concentrate	5,086	4,551	NA.
Roasted pyrite	195,784	139,198	Mainly to Belgium-Luxembourg.

See footnotes at end of table.

Table 3.—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Iron and steel—Continued			
Metal:			
Scrap ---thousand tons--	2,545	2,206	Italy 1,763; Belgium-Luxembourg 132.
Pig iron including cast iron --do----	1,361	763	France 274; Italy 169.
Sponge iron, powder and shot--do----	27	22	Italy 3; Netherlands 3; Switzerland 3; France 2.
Spiegeleisen ---do----	4	2	Italy 1; Switzerland 1.
Ferroalloys:			
Ferrochrome ---do----	41	31	Italy 7; United States 6; Belgium-Luxembourg 5; France 4.
Ferromanganese ---do----	79	41	Belgium-Luxembourg 12; France 8; Italy 4; Canada 3; Netherlands 3.
Ferronickel	147	53	All to Belgium-Luxembourg.
Ferrosilicon ---thousand tons--	24	16	Italy 2; Austria 1; France 1; Netherlands 1.
Ferrosilicochrome ---do----	1	1	Mainly to Italy.
Ferrosilicomanganese	1,213	567	Switzerland 283; Italy 100; Belgium-Luxembourg 89.
Other ---thousand tons--	17	13	Italy 2; Romania 2; Austria 1; France 1; Spain 1; Sweden 1.
Steel, primary forms ---do----	2,622	2,345	France 345; Belgium-Luxembourg 302; United Kingdom 258; Italy 222.
Semimanufactures:			
Bars, rods, angles, shapes, sections do----	6,086	3,684	France 750; Poland 243; U.S.S.R. 226.
Universals, plates, sheets--do----	7,898	5,268	U.S.S.R. 911; France 726; Netherlands 475; United States 381.
Hoop and strip ---do----	1,340	883	U.S.S.R. 137; Netherlands 110; France 94; Poland 70.
Rails and accessories ---do----	210	278	Republic of South Africa 97; Italy 45; Poland 33; Netherlands 27.
Wire ---do----	493	286	France 45; Netherlands 40; Belgium-Luxembourg 25.
Tubes, pipes, fittings ---do----	3,710	3,635	U.S.S.R. 986; Netherlands 566; France 155; United Kingdom 151; Poland 148.
Castings and forgings, rough do----	102	94	France 16; Belgium-Luxembourg 14; Netherlands 10.
Lead:			
Ore and concentrate	3,689	3,433	Belgium-Luxembourg 2,040; Austria 1,080.
Oxides	10,404	8,880	Netherlands 4,185; Sweden 1,195.
Metal including alloys:			
Scrap	16,701	17,769	Netherlands 6,762; Belgium-Luxembourg 4,133; Italy 4,054; France 2,381.
Unwrought	87,749	80,902	Italy 30,343; Netherlands 12,488; France 10,322; Czechoslovakia 8,170.
Semimanufactures	11,474	8,662	Denmark 1,322; Switzerland 1,117; Belgium-Luxembourg 927; Sweden 900.
Lithium:			
Ore and concentrate	267	186	NA.
Oxides and hydroxides	NA	517	Italy 115; France 104; Belgium-Luxembourg 70.
Metal, all forms	NA	15	Switzerland 12; France 2.
Magnesium:			
Oxides, hydroxides, peroxides	4,694	3,063	Italy 826; Austria 318.
Metal including alloys:			
Scrap	3,268	1,507	Italy 501; Netherlands 361; United Kingdom 276; Ireland 172.
Unwrought	477	336	Sweden 59; Netherlands 54; Austria 50; France 37.

See footnotes at end of table.

Table 3.—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Magnesium—Continued			
Metals including alloys—Continued			
Semimanufactures	472	1,507	Italy 502; Netherlands 346; United Kingdom 276; Ireland 172.
Manganese:			
Ore and concentrate	1,296	3,274	Netherlands 1,843; Cameroon 515.
Oxides	3,321	2,777	France 39.
Metal	204	161	Switzerland 59; France 26.
Mercury ---76-pound flasks	2,491	1,682	Switzerland 290; Egypt 174; Netherlands 174.
Molybdenum:			
Ore and concentrate	327	654	Czechoslovakia 286; Belgium-Luxembourg 177.
Metal including alloys, all forms	769	779	Romania 265; Italy 69.
Nickel:			
Ore and concentrate	4	NA	
Matte and speiss	72	NA	
Metal including alloys:			
Scrap	3,788	3,013	Sweden 1,302; Netherlands 721; United Kingdom 331.
Unwrought	2,062	2,111	Netherlands 1,042.
Semimanufactures	15,954	13,676	France 2,225; United Kingdom 1,890; United States 1,196; Netherlands 1,059.
Platinum-group metals:			
Platinum:			
Ash and waste ---kilograms	[4] 900,933	NA	
Scrap and sweepings thousand troy ounces	861	(1)	NA.
Metal including alloys, all forms do	NA	228	Netherlands 50; Switzerland 48.
Palladium metal including alloys, all forms do	NA	246	Switzerland 97; Netherlands 49.
Other metals including alloys, all forms do	NA	97	Hong Kong 27.
Silicon metal including alloys, all forms	151	117	United States 37; U.S.S.R. 30; Japan 15.
Silver:			
Ash and residue ---kilograms	[4] 900,933	25,524	Belgium-Luxembourg 17,949; Switzerland 7,575.
Scrap and sweepings thousand troy ounces	45,794	37	NA.
Metal including alloys, all forms do	NA	26	Austria 4; United Kingdom 3; Italy 2.
Tin:			
Ore and concentrate	7	NA	
Oxides	520	402	France 88; Spain 32.
Metal including alloys:			
Scrap	246	207	Netherlands 165; France 40.
Unwrought	1,607	1,716	Netherlands 918; France 217.
Semimanufactures	915	823	Belgium-Luxembourg 131; Norway 83.
Titanium:			
Ore and concentrate	1,044	946	France 270; Turkey 143; Netherlands 119; Morocco 110; Switzerland 100.
Oxides	62,651	32,044	Italy 4,094; United States 4,007.
Metal including alloys, all forms	602	364	Mainly to United Kingdom.
Tungsten:			
Ore and concentrate	141	494	Italy 195; France 102; United Kingdom 77; Sweden 50.
Oxide and hydroxide	NA	5,306	Austria 1,052; Belgium-Luxembourg 886; Poland 717; France 664.
Metal including alloys, all forms	20	602	France 15; Netherlands 3; Brazil 2.
Uranium and thorium:			
Uranium, thorium, rare-earth compounds	700	3	NA.
Metal including alloys, all forms kilograms	6,000	49	United States 9.

See footnotes at end of table.

Table 3.—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Vanadium:			
Oxides, hydroxides, pentoxides	NA	5,306	Austria 1,052; Belgium-Luxembourg 886; Poland 717; France 664.
Metal including alloys, all forms	r 15,300	30	France 25; United Kingdom 5.
Zinc:			
Ore and concentrate	76,116	64,158	Netherlands 31,556; Belgium-Luxembourg 27,026; France 5,537.
Oxide and peroxide	12,265	8,850	NA.
Metal including alloys:			
Scrap	12,194	6,934	Netherlands 3,248; France 1,512; Italy 1,392.
Dust	6,515	5,092	Netherlands 1,731; Italy 1,134.
Unwrought	81,457	77,388	United States 19,345; Italy 11,683; Netherlands 9,722; United Kingdom 9,443.
Semimanufactures	17,459	9,743	France 1,605; Netherlands 1,603; United Kingdom 1,378.
Zirconium metal including alloys, all forms	110	104	United States 58; Japan 20; Sweden 12.
Other:			
Ore and concentrate:			
Of columbium, tantalum, vanadium	[5] 2,945	776	United States 362; Netherlands 218; Japan 146.
Of zirconium	NA	4,177	Netherlands 996; Austria 888; Italy 535.
Of base metals, n.e.s	7	21	NA.
Ash and residue containing nonferrous metals, n.e.s	227,554	147,935	Netherlands 50,008; Belgium-Luxembourg 34,113; Sweden 23,579; France 12,260.
Oxides, hydroxides, and peroxides of metals, n.e.s	9,346	8,536	Austria 1,066; Belgium-Luxembourg 954; France 920.
Metals including alloys, all forms:			
Metalloids:			
Arsenic and tellurium	25	7	Netherlands 2; United States 1.
Selenium and phosphorus	9,874	10,380	NA.
Silicon	1,618	9,546	Netherlands 3,700; Norway 2,984.
Alkali, alkaline-earth, rare-earth metals	75	59	Italy 9.
Base metals including alloys, all forms n.e.s	654	581	France 191; Japan 83; United States 70.
NONMETALS			
Abrasives:			
Natural:			
Pumice, emery, natural corundum, etc	297,325	633,594	Netherlands 546,344; Belgium-Luxembourg 76,653.
Dust and powder of precious and semi-precious stones—thousand carats	820	(1)	NA.
Grinding and polishing wheels and stones	12,397	10,316	France 1,424; Netherlands 1,044.
Artificial:			
Corundum	43,927	30,807	Netherlands 4,044; Sweden 3,615.
Silicon carbide	11,829	16,894	NA.
Asbestos	57,148	77,769	France 11,535; Spain 8,991; Iran 8,175.
Barite and witherite	54,317	46,992	U.S.S.R. 15,327; France 5,766; Sweden 3,921.
Boron materials:			
Crude and natural borates	20,338	14,375	Belgium-Luxembourg 5,437; Italy 4,466; Sweden 2,420.
Oxide and acid	334	19	NA.
Bromine	162	269	Poland 102; Italy 100; Switzerland 51.
Cement—thousand tons	2,795	2,071	Netherlands 1,265; Poland 212; Nigeria 191.
Chalk	16,727	13,589	Sweden 5,298; Netherlands 3,644; Finland 1,424.

See footnotes at end of table.

Table 3.—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Clays and clay products (including nonclay refractory brick):			
Crude clays:			
Bentonite ---thousand tons--	37	33	France 13; Belgium-Luxembourg 7; Netherlands 4.
Ceramic clays:			
Kaolin ---do---	r 111	108	Austria 28; Netherlands 28; Italy 19; Belgium-Luxembourg 14; France 10.
Other ---do---	r 549	412	Italy 112; Netherlands 107; France 95; Belgium-Luxembourg 62.
Fire clays:			
Raw ---do---	341	174	Italy 60; Netherlands 35; Belgium-Luxembourg 22; Austria 18; France 18.
Burned including chamotte-do---	77	63	France 16; Italy 13; Netherlands 11; Switzerland 8.
Fuller's earth ---do---	2	(1)	NA.
Kyanite, sillimanite, andalusite, mullite ---do---	r 18	5	Austria 1.
Other ---do---	999	281	Netherlands 194; Belgium-Luxembourg 62.
Products:			
Refractory (including nonclay bricks) do---	926	684	France 120; Belgium-Luxembourg 83.
Nonrefractory ---do---	660	649	France 158; Belgium-Luxembourg 154; Netherlands 119.
Cryolite and chiolite	NA	(1)	NA.
Diamond:			
Gem:			
Crude or rough cut-thousand carats--	10	5	NA.
Other ---do---	75	1,510	People's Republic of China 430; France 245; Hong Kong 205; Italy 175.
Industrial ---do---	210	120	Netherlands 45; Switzerland 30; Belgium-Luxembourg 20; Ireland 20.
Diatomite and other infusorial earth	r 5,174	19,182	France 3,607; Italy 3,437; Netherlands 3,414; Switzerland 1,910.
Feldspar, leucite, nepheline, nepheline syenite	22,884	10,849	Czechoslovakia 2,363; Poland 1,413; Belgium-Luxembourg 1,328; Italy 1,327.
Fertilizer materials:			
Crude:			
Phosphatic	11,902	7,797	Czechoslovakia 4,980; Hungary 2,140.
Potassic	43,117	42,986	Belgium-Luxembourg 27,976; United Kingdom 8,285; Netherlands 6,530.
Manufactured:			
Nitrogenous ---thousand tons--	1,579	950	Belgium-Luxembourg 347; Netherlands 106; United States 88; France 60.
Phosphatic:			
Thomas slag ---do---	39	NA	
Other ---do---	16	83	Hungary 55; Brazil 15.
Potassic ---do---	2,228	1,794	Belgium-Luxembourg 287; United Kingdom 179.
Mixed ---do---	960	678	Belgium-Luxembourg 104; France 102; Denmark 96; India 72.
Ammonia, anhydrous ---do---	71	NA	
Fluorspar	15,907	7,910	Denmark 3,021; Austria 1,306.
Graphite, natural	10,790	6,107	Italy 1,605; United States 726.
Gypsum and plaster	333,013	286,121	Netherlands 178,497; Switzerland 46,973.
Iodine	52	28	Netherlands 11.
Lime	567,090	420,728	Netherlands 353,249; France 40,363.
Magnesite	6,982	7,734	France 5,135.

See footnotes at end of table.

Table 3:—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Mica:			
Crude including splittings and waste	912	768	Switzerland 232; Yugoslavia 106; Austria 82.
Worked including agglomerated splittings	303	204	United Kingdom 42; Austria 20.
Pigments, mineral:			
Natural, crude	7,315	3,237	Netherlands 1,884.
Iron oxide and hydroxides	152,013	89,387	France 11,227; United Kingdom 9,922; United States 8,748.
Precious and semiprecious stones, except diamond:			
Natural ---kilograms	176,613	319,972	People's Republic of China 85,808; France 50,633; Hong Kong 41,483.
Manufactured ---do	5,380	7,121	United States 2,710; Italy 1,443; Japan 943.
Pyrite (gross weight)	594	500	NA.
Salt ---thousand tons	2,207	1,589	Sweden 286; Denmark 65; Nigeria 25.
Sodium and potassium compounds, n.e.s.:			
Caustic soda ---do	518	NA	
Caustic potash, sodic and potassic peroxide ---do	162	NA	
Stone, sand and gravel:			
Dimension stone:			
Crude or partly worked:			
Calcareous	3,109	2,868	Austria 1,459; Switzerland 355.
Slate	17,968	13,338	Netherlands 6,384; Belgium-Luxembourg 4,708.
Other	267,311	459,034	Netherlands 358,667; Switzerland 81,527.
Worked:			
Building and monumental stone	17,429	15,350	Belgium-Luxembourg 3,461; Netherlands 2,990; France 2,802.
Paving and flagstone	26,592	9,052	Netherlands 2,216; Denmark 2,158; Belgium-Luxembourg 1,504; France 1,353.
Slate	825	649	Netherlands 317; Switzerland 89.
Dolomite	193,327	170,675	France 63,856; Netherlands 60,072; Belgium-Luxembourg 37,026.
Gravel and crushed rock---thousand tons	11,241	4,395	Netherlands 3,322; France 646; Belgium-Luxembourg 151; Switzerland 84; Austria 69.
Limestone ---do	155	46	Netherlands 29; Belgium-Luxembourg 14.
Quartz and quartzite:			
Quartz crystal ---kilograms	46	52	NA.
Other	63,736	59,937	Belgium-Luxembourg 15,877; Austria 13,883; France 6,135.
Sand, excluding metal bearing thousand tons	7,704	7,367	Netherlands 6,147.
Sulfates, natural, magnesium sulfate (Kieserite) ---do	468	445	Norway 68; Netherlands 60; France 45.
Sulfur:			
Elemental:			
Other than colloidal	140,526	199,018	Denmark 69,889; Netherlands 59,307; Switzerland 27,936.
Colloidal	3,756	2,516	United Kingdom 475; Republic of South Africa 312; Italy 291.
Sulfur dioxide	16,301	15,019	Sweden 6,325; Belgium-Luxembourg 3,975; Austria 2,146.
Sulfuric acid	427,349	737,921	Netherlands 124,834; Turkey 93,673; France 87,854; Belgium-Luxembourg 82,067.
Talc, steatite, soapstone	7,115	5,748	Denmark 3,021; Belgium-Luxembourg 569.
Vermiculite, chlorite, perlite	639	473	NA.

See footnotes at end of table.

Table 3.—Federal Republic of Germany: Exports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Other nonmetals,, n.e.s.:			
Crude:			
Meerschaum, amber, jet--kilograms--	1,700	3	NA.
Pottery, broken ----------	r 32,116	22,402	Netherlands 9,770; France 6,109; Austria 2,810.
Other ----------thousand tons--	889	1,361	Netherlands 1,220.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture do----	3,282	2,328	Netherlands 2,250.
Slag and ash, n.e.s ----------do----	913	1,056	Netherlands 895; France 125.
Oxides and hydroxides of strontium and barium ----------	5,804	2,441	France 952; United States 706; Belgium-Luxembourg 292.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural ----------	866	2,667	Netherlands 1,559; Austria 585.
Carbon black ----------	94,385	90,411	France 18,343; Austria 12,198; Poland 11,265.
Coal and briquets:			
Anthracite and bituminous thousand tons--	17,444	14,468	France 5,522; Belgium-Luxembourg 3,754; Italy 3,020.
Briquets of anthracite and bituminous coal do----	239	240	Belgium-Luxembourg 123; Austria 37; France 29.
Lignite and lignite briquets ------do----	680	486	France 190; Austria 151; Belgium-Luxembourg 63.
Coke and semicoke ----------do----	13,082	7,372	Sweden 546; Netherlands 421; Romania 139.
Gas, natural ----------do----	299	275	Switzerland 112; Belgium-Luxembourg 48; Denmark 32; Netherlands 30.
Helium and other rare gases ----------	23,135	NA	
Peat and briquets ----------thousand tons--	337	399	Netherland 243; Switzerland 57; France 47.
Petroleum refinery products:			
Gasoline, motor spirit thousand 42-gallon barrels--	7,747	5,729	Switzerland 2,482; Austria 2,134; Czechoslovakia 357; France 315.
Kerosine, white spirit ----------do----	9,316	8,765	Denmark 628; Switzerland 581; Norway 372; Netherlands 132.
Distillate fuel oil ----------do----	13,495	8,691	Switzerland 3,342; France 1,209; Netherlands 455; Austria 380.
Residual fuel oil ----------do----	27,140	18,565	Austria 2,644; Denmark 1,918; France 1,465; Belgium-Luxembourg 1,359; Sweden 1,052.
Lubricants ----------do----	2,958	2,814	Belgium-Luxembourg 483; United Kingdom 322; Sweden 294; Netherlands 252.
Mineral jelly and wax ----------do----	1,186	929	Italy 102; Netherlands 87; Denmark 63; Sweden 63.
Other ----------do----	19,292	13,580	France 4,137; Netherlands 2,548; United Kingdom 1,435; Spain 623; Sweden 609.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals-thousand tons--	359	187	Netherlands 54; Belgium-Luxembourg 36; France 32; United Kingdom 23.

r Revised. NA Not available.
[1] Value only reported at $58,258.
[2] Less than ½ unit.
[3] Reported in 1975 as "ashes, residue, and scrap."
[4] Platinum and silver combined in 1974.
[5] Includes zirconium ore and concentrate.

Table 4.—Federal Republic of Germany: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite ---thousand tons--	434	421	Australia 276; Guinea 78.
Alumina	499,149	471,753	Italy 208,420; Australia 134,849; Surinam 106,258.
Aluminum hydroxide	1,570	2,541	United States 1,989; France 471.
Metal including alloys:			
Scrap	77,170	44,016	Netherlands 12,907; United States 10,185.
Unwrought	338,942	169,111	Norway 76,180; Netherlands 15,523; Italy 14,806.
Semimanufactures	144,955	140,305	France 37,907; Belgium-Luxembourg 36,878; Netherlands 26,983.
Antimony:			
Ore and concentrate	3,369	2,129	Turkey 602; Austria 372; Bolivia 335; Republic of South Africa 323; Chile 272.
Metal including alloys, all forms	924	841	Belgium-Luxembourg 626; People's Republic of China 124.
Arsenic hydroxide	975	957	France 481; Belgium-Luxembourg 219; Sweden 128.
Beryllium metal including alloys, all forms ---kilograms--	5,384	496	Mainly from United States.
Bismuth metal including alloys, all forms	129	259	United Kingdom 47; Japan 21; Mexico 20.
Cadmium metal including alloys, all forms	1,094	631	Belgium-Luxembourg 139; Japan 108; North Korea 75.
Chromium:			
Chromite	386,545	561,035	U.S.S.R. 168,129; Republic of South Africa 136,930; Turkey 78,917.
Oxide and hydroxide	1,309	2,273	U.S.S.R. 1,853; Netherlands 143.
Metal including alloys, all forms	551	391	Japan 206; United Kingdom 84; France 62.
Cobalt metal including alloys, all forms	1,956	14,451	Zaire 6,856; Belgium-Luxembourg 3,420; United States 1,864.
Columbium and tantalum metal including alloys, all forms:			
Columbium ---kilograms--	6,349	4,769	Mainly from United States.
Tantalum ---do---	89,107	138,994	United States 118,118; Japan 13,321.
Copper:			
Ore and concentrate	571,146	564,352	Papua New Guinea 271,042; Chile 61,387; Republic of South Africa 60,705.
Matte	743	2,051	Australia 1,086; United Kingdom 887.
Copper sulfate	7,563	6,349	France 3,541; Belgium-Luxembourg 1,310.
Metal including alloys:			
Scrap	106,534	89,294	United Kingdom 16,650; United States 15,053.
Unwrought:			
Blister	98,160	119,850	Republic of South Africa 55,678; Chile 34,422.
Refined	440,025	393,936	Chile 83,342; Zambia 75,987; Belgium-Luxembourg 36,475.
Alloys	32,693	39,086	United Kingdom 9,767; Poland 8,329.
Master alloys	1,500	1,235	United Kingdom 968.
Semimanufactures	674,602	115,190	Belgium-Luxembourg 42,012; France 33,457; Italy 12,819.
Gallium metal including alloys, all forms ---kilograms--	NA	4,700	Belgium-Luxembourg 1,200; Japan 1,200; U.S.S.R. 1,200; Netherlands 700.
Gold:			
Ash and waste ---do---	[1] 221,457	96,946	United States 60,058; Austria 15,463; Switzerland 12,008.
Scrap and sweepings ---thousand troy ounces--	(1)	1,154	Italy 286; Belgium-Luxembourg 253; United States 160.
Metal:			
Unwrought ---do---	3,123	2,122	Switzerland 1,125; Republic of South Africa 418.
Semimanufactures ---do---	166	19	United States 6; France 4; Switzerland 4.

See footnotes at end of table.

Table 4.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Hafnium metal including alloys, all forms kilograms	NA	2	NA.
Iron and steel:			
Ore and concentrate thousand tons	57,720	44,322	Liberia 6,196; India 982; Spain 879; Sierra Leone 614; Peru 593.
Roasted pyrite do	792	843	Spain 587; Belgium-Luxembourg 156; Portugal 75.
Metal:			
Scrap do	1,811	1,720	Netherlands 818; United Kingdom 309; Belgium-Luxembourg 263; France 204.
Pig iron including cast iron do	189	158	Canada 42; U.S.S.R. 28; France 22; Norway 18.
Sponge iron, powder and shot do	40	38	France 13; Sweden 13; United Kingdom 7.
Spiegeleisen	351	503	Mainly from Belgium-Luxembourg.
Ferroalloys:			
Ferrochrome thousand tons	81	88	Republic of South Africa 49; Japan 11.
Ferromanganese do	167	157	Norway 57; France 47.
Ferronickel do	56	38	New Caledonia 16; Greece 15; Dominican Republic 3; Japan 3.
Ferrosilicon do	134	116	Norway 47; France 28.
Ferrosilicochrome do	22	13	Republic of South Africa 8; France 2.
Ferrosilicomanganese do	73	70	Norway 43; Czechoslovakia 8.
Other do	189	8	Belgium-Luxembourg 2; Brazil 1; United Kingdom 1.
Steel, primary forms do	2,035	1,859	Netherlands 455; Japan 187; Australia 170; Austria 144.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	2,528	2,690	France 511; Italy 397; Spain 107; Netherlands 91; United Kingdom 82.
Universals, plates, sheets do	2,974	3,185	France 594; Japan 328; Austria 291; Netherlands 189; Italy 164.
Hoop and strip do	484	456	Belgium-Luxembourg 240; France 108; Netherlands 50.
Rails and accessories do	18	20	Netherlands 8; Sweden 4; Sierra Leone 3.
Wire do	176	156	Belgium-Luxembourg 71; France 34; Netherlands 10.
Tube, pipes, fittings do	558	538	Italy 140; Netherlands 93; France 90; Belgium-Luxembourg 67.
Castings and forgings, rough do	34	25	France 5; Netherlands 5; Romania 4; Poland 3.
Lead:			
Ore and concentrate	184,036	208,978	Canada 50,788; Sweden 36,383; United States 27,259; Ireland 26,507.
Oxides	4,994	3,765	Belgium-Luxembourg 2,194; Italy 415.
Metal including alloys:			
Scrap	35,773	10,205	United Kingdom 3,742; Netherlands 1,872; Sweden 1,614.
Unwrought	128,693	122,829	United Kingdom 37,701; Australia 17,829; Sweden 10,459.
Semimanufactures	2,433	1,885	Belguim-Luxembourg 1,065; France 271; Netherlands 235.
Lithium:			
Ore and concentrate	4,243	3,521	Republic of South Africa 2,997; United States 320.
Oxides and hydroxides	NA	457	United States 253; U.S.S.R. 107; France 70.
Metal all forms	NA	26	United States 21; U.S.S.R. 3.
Magnesium:			
Oxide, hydroxide, peroxide	6,417	3,409	United States 944; France 919; Netherlands 731.

See footnotes at end of table.

Table 4.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Magnesium—Continued			
Metal including alloys:			
Scrap	1,450	3,847	Belgium-Luxembourg 1,515; Netherlands 973; Czechoslovakia 384.
Unwrought	37,405	19,503	Norway 7,099; Italy 4,021; France 2,361; U.S.S.R. 1,975.
Semimanufactures	620	--	
Manganese:			
Ore and concentrate—thousand tons	828	733	Republic of South Africa 429; Australia 161; Brazil 79.
Oxides	2,061	1,449	Belgium-Luxembourg 1,114; Japan 108.
Metal	4,815	4,365	Republic of South Africa 2,795; France 463.
Mercury—76-pound flasks	12,151	77	Italy 25; U.S.S.R. 15; Spain 10.
Molybdenum:			
Ore and concentrate	17,556	14,736	United States 6,566; Netherlands 2,978; Canada 1,896; Chile 1,889.
Metal including alloys, all forms	372	376	Austria 236; United States 73.
Nickel:			
Matte and speiss	6,145	6,550	Australia 3,550; Canada 2,881.
Metal including alloys:			
Scrap	8,160	6,453	United Kingdom 1,441; United States 1,019; France 742; Netherlands 719.
Unwrought	44,306	36,387	United Kingdom 8,128; Canada 5,144; Republic of South Africa 4,719; Australia 4,246.
Semimanufactures	3,901	4,416	Australia 1,187; United Kingdom 905; Belgium-Luxembourg 793.
Platinum-group metals:			
Platinum:			
Ash and waste—kilograms	NA	275,580	United Kingdom 71,478; Netherlands 49,046; Romania 40,634; United States 38,533.
Scrap and sweepings thousand troy ounces	NA	126	United States 44; Netherlands 26; Hungary 12.
Metal including alloys, all forms do	NA	286	United Kingdom 126; Italy 36; United States 30.
Palladium metal including alloys, all forms do	NA	368	U.S.S.R. 116; United Kingdom 96; United States 80; Belgium-Luxembourg 38.
Other metals including alloys, all forms do	NA	77	Republic of South Africa 31; United States 19; United Kingdom 18.
Silicon metal including alloys, all forms	38,294	294,120	Norway 100,261; France 67,700.
Silver:			
Ash and waste—kilograms	NA	265,186	United States 117,437; Norway 31,503; Switzerland 27,986.
Scrap and sweepings thousand troy ounces	NA	3,374	Sweden 1,306; Netherlands 562; France 551.
Metal including alloys, all forms—do	NA	31,672	Belgium-Luxembourg 6,132; Sweden 4,454; North Korea 2,985.
Tin:			
Ore and concentrate	10,816	9,883	Bolivia 9,114.
Oxides	108	54	France 42; Japan 6.
Metal including alloys:			
Scrap	385	449	Netherlands 214; Peru 46.
Unwrought	17,785	13,957	Indonesia 3,520; Thailand 3,171; Malaysia 2,043; United Kingdom 1,702.
Semimanufactures	488	609	Netherlands 489.
Titanium:			
Ore and concentrate	528,438	330,191	Norway 220,551; Canada 57,859; Australia 38,642.

See footnotes at end of table.

Table 4.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Titanium—Continued			
Oxides	21,382	19,533	Belgium-Luxembourg 9,283; Netherlands 4,497; France 2,178; Italy 2,045.
Metal including alloys, all forms	3,807	3,483	U.S.S.R. 2,591; Japan 460.
Tungsten:			
Ore and concentrate	4,246	3,365	France 1,175; Australia 415; People's Republic of China 394; Portugal 357.
Oxide and hydroxide	NA	174	People's Republic of China 144; United Kingdom 19.
Metal including alloys, all forms	505	91	United States 35; France 21; Austria 13.
Uranium and thorium:			
Ore and concentrate	560	7	NA.
Uranium, thorium, rare-earth compounds	939	3	NA.
Metal including alloys, all forms kilograms	210	42,900	Mainly from France.
Vanadium:			
Oxides, hydroxides, pentoxides	NA	408	Finland 362; Republic of South Africa 28.
Metal including alloys, all forms	14	5	Mainly from Netherlands.
Zinc:			
Ore and concentrate	640,056	550,888	Canada 213,696; Sweden 70,259; Republic of South Africa 62,926.
Oxide and peroxide	5,898	4,374	France 1,762; Netherlands 908.
Metal including alloys:			
Scrap	5,177	5,414	Denmark 1,165; United Kingdom 1,040; Belgium-Luxembourg 1,010; Netherlands 928.
Dust	12,928	8,838	Belgium-Luxembourg 7,744.
Unwrought	94,870	90,535	Belgium-Luxembourg 49,503.
Semimanufactures	18,220	17,738	France 7,494; Yugoslavia 3,263; Netherlands 2,670; Belgium-Luxembourg 2,477.
Zirconium metal including alloys, all forms	321	332	United States 264; France 32.
Other:			
Ore and concentrate:			
Of columbium, tantalum, vanadium	26,537	2,097	Brazil 1,053; United States 282; Canada 278.
Of zirconium	NA	24,761	Australia 18,073; Malaysia 2,842.
Of base metals, n.e.s	3,279	4,143	Australia 3,703.
Ash and residue containing nonferrous metals	278,444	277,449	Canada 72,673; Italy 27,753.
Oxides, hydroxides, peroxides of metals, n.e.s	6,371	3,873	Belgium-Luxembourg 1,421; France 1,143; United Kingdom 585.
Metals including alloys, all forms:			
Metalloids:			
Arsenic and tellurium	81	32	U.S.S.R. 13; Japan 4.
Selenium and phosphorus	25,726	18,349	NA.
Alkali, alkaline-earth, rare-earth metals	337	269	Mainly from France.
Pyrophoric alloys, all forms	30	55	Denmark 3.
Base metals including alloys, all forms	353	840	Sweden 472; United States 134.
NONMETALS			
Abrasives:			
Natural:			
Pumice, emery, natural corundum, etc	74,259	34,939	Greece 26,311; Italy 4,268.
Dust and powder of precious and semiprecious stones kilograms	1,456	1,242	United States 652; Ireland 303; Netherlands 134.
Grinding and polishing wheels and stones	6,211	4,655	Austria 1,114; Spain 597; Netherlands 593; Italy 577.
Artificial:			
Corundum	25,842	22,634	Netherlands 7,685; Hungary 4,590; Austria 2,477; United Kingdom 2,452.
Silicon carbide	45,464	49,557	Norway 10,638.

See footnotes at end of table.

Table 4.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Asbestos	399,561	386,188	Canada 294,580.
Barite and witherite	165,336	91,156	U.S.S.R. 15,327.
Boron materials:			
Crude natural borates	194,426	116,951	United States 71,109; Turkey 44,989.
Oxide and acid	15,574	11,623	France 4,706; Turkey 2,975; United States 1,815.
Bromine	1,625	1,805	Israel 1,206; United Kingdom 365; France 212.
Cement—thousand tons	679	540	France 252; Belgium-Luxembourg 120; Netherlands 81.
Chalk—do	85	69	France 64.
Clays and clay products (including all refractory brick):			
Crude clays:			
Bentonite—do	107	44	United States 33; Greece 4.
Ceramic clays:			
Kaolin—do	768	555	United Kingdom 309; United States 76; France 73; Czechoslovakia 71.
Other—do	110	109	Czechoslovakia 35; France 30; Netherlands 24; United Kingdom 19.
Fire clays:			
Raw—do	660	85	Czechoslovakia 23; United States 21; France 15; Netherlands 8.
Burned, including chamotte—do	195	182	Czechoslovakia 66; United States 43; Republic of South Africa 39.
Fuller's earth—do	9	9	Spain 7; United States 2.
Kyanite, sillimanite, andalusite, mullite—do	25	24	India 6; Republic of South Africa 6; United Kingdom 3; United States 2.
Other—do	305	41	Netherlands 19; France 9; Switzerland 9.
Products:			
Refractory (including nonclay bricks)—do	288	245	Austria 69; Czechoslovakia 39; France 29.
Nonrefractory—do	1,002	1,048	France 471; Italy 247; France 103.
Cryolite and chiolite	2,668	1,955	Mainly from Denmark.
Diamond:			
Gem:			
Crude or rough cut—thousand carats	100	70	NA.
Other—do	405	11,810	Brazil 6,665; United States 1,405.
Industrial—do	850	860	Republic of South Africa 290; Belgium-Luxembourg 230; Netherlands 220.
Diatomite and other infusorial earth	r 95,926	87,261	Denmark 43,371; Belgium-Luxembourg 28,165.
Feldspar, leucite, nepheline, nepheline syenite	59,120	102,585	Norway 78,259; France 10,719.
Fertilizer materials:			
Crude:			
Nitrogenous	312	NA	
Phosphatic—thousand tons	3,089	2,292	U.S.S.R. 631; Morocco 363.
Manufactured:			
Nitrogenous	639,019	866,567	Belgium-Luxembourg 284,127; Netherlands 216,048; France 96,763; Romania 93,530.
Phosphatic:			
Thomas slag	818,536	NA	
Other	37,790	735,623	Belgium-Luxembourg 664,771.
Potassic	84,281	61,211	All from France.
Mixed	331,515	340,766	France 134,150; Belgium-Luxembourg 97,537; Netherlands 43,691; United Kingdom 40,236.
Ammonia, anhydrous	157,315	NA	
Fluorspar	285,472	261,094	Spain 57,807; Italy 24,752.

See footnotes at end of table.

Table 4.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Graphite, natural	26,787	26,043	Austria 4,514; People's Republic of China 4,362; Norway 2,713.
Gypsum and plaster	285,099	303,321	France 174,943; Austria 113,804.
Iodine	884	864	Japan 643; Chile 217.
Magnesite	435,577	403,344	Greece 129,396; North Korea 47,117; Austria 44,242.
Mica:			
Crude including splittings and waste	9,505	8,008	India 2,493; People's Republic of China 1,755; Norway 992; Republic of South Africa 902.
Worked including agglomerated splittings	654	599	France 293; Belgium-Luxembourg 184.
Pigments, mineral:			
Natural crude	1,883	1,876	Mainly from Austria.
Iron oxides and hydroxides	2,385	2,849	Netherlands 781; France 601; India 452.
Precious and semiprecious stones, except diamond:			
Natural ——kilograms	2,477	9,530	India 2,056; Republic of South Africa 1,935.
Manufactured ——do	21	22,551	Switzerland 12,574; France 3,267; Japan 3,035.
Pyrite (gross weight) ——thousand tons	780	498	U.S.S.R. 260; Norway 120.
Salt	777,476	641,976	Netherlands 563,414.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	r 93,850	NA	
Caustic potash, sodic and potassic peroxides	2,210	NA	
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	166,033	192,518	Austria 55,578; Belgium-Luxembourg 44,904; Italy 35,594.
Slate	15,089	13,290	Spain 4,059; Portugal 2,774; Netherlands 1,942; United Kingdom 1,640.
Other	317,297	343,496	Sweden 65,182; Austria 55,586; Denmark 50,715; Republic of South Africa 42,435.
Worked:			
Building and monumental stone	423,065	407,946	Italy 359,688.
Paving stones, flagstone and related materials	141,032	135,510	Portugal 76,812; Romania 17,884; Poland 15,506.
Slate	10,673	9,181	Spain 3,015; Italy 2,286; France 1,145.
Dolomite including burned	934,624	684,877	Belgium-Luxembourg 617,399.
Gravel and crushed rock—thousand tons	16,302	16,084	France 10,168; Denmark 2,724.
Limestone ——do	1,605	1,446	Austria 860; Belgium-Luxembourg 139.
Quartz and quartzite:			
Quartz crystal ——kilograms	147	479	Japan 95; United States 66.
Other	137,089	127,381	Belgium-Luxembourg 51,789; Yugoslavia 20,830; Sweden 18,150.
Sand, excluding metal bearing thousand tons	3,593	3,086	France 1,911; Netherlands 794.
Sulfates, natural: Magnesium sulfate (Kieserite)	43	NA	
Sulfur:			
Elemental:			
Other than colloidal	471,836	303,908	Poland 180,938; Canada 59,810; United States 45,017.
Colloidal	229	519	Mainly from France.
Sulfur dioxide	348	1,275	Mainly from Switzerland.
Sulfuric acid	180,360	43,918	Mainly from France.
Talc, steatite, soapstone	210,359	87,517	Austria 34,466; France 14,944; Italy 13,341; Norway 8,986.
Vermiculite, chlorite, perlite	82,016	94,103	Greece 62,342; Republic of South Africa 17,986; Hungary 12,172.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet	7,159	9,267	Spain 9,259.
Pottery, broken	70,169	68,982	Netherlands 17,807; U.S.S.R. 11,320; France 10,508; Austria 8,531.

See footnotes at end of table.

Table 4.—Federal Republic of Germany: Imports of mineral commodities —Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Other nonmetals, n.e.s—Continued			
Crude—Continued			
Other	423,189	445,154	France 205,198; Norway 73,079; Austria 69,848.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture thousand tons	1,158	1,527	Belgium-Luxembourg 706; France 606.
Slag and ash, n.e.s ---do---	166	183	Belgium-Luxembourg 78; France 42; Czechoslovakia 31; Denmark 19.
Oxide and hydroxide of strontium and barium	585	120	NA.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	23,451	19,253	Mainly from Trinidad and Tobago.
Carbon black	36,296	30,001	Netherlands 13,033; France 8,353.
Coal and briquets:			
Anthracite and bituminous thousand tons	5,837	6,244	Republic of South Africa 521; United Kingdom 385; France 317; Belgium-Luxembourg 270.
Briquets of anthracite and bituminous coal ---do---	14	4	All from France.
Lignite and lignite briquets ---do---	1,349	1,647	Mainly from Czechoslovakia.
Coke and semicoke ---do---	1,288	1,283	United States 480; United Kingdom 185; Australia 103.
Gas, natural ---do---	22,020	23,702	NA.
Peat and briquets ---do---	24	24	U.S.S.R. 12; Netherlands 8; Poland 3.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	717,801	618,898	Saudi Arabia 123,620; Libya 103,565; Iran 96,516; Algeria 71,498.
Refinery products:			
Gasoline, motor spirit ---do---	23,800	34,060	Netherlands 17,085; France 4,004; Italy 3,477; Belgium-Luxembourg 3,375.
Kerosine, white spirit ---do---	10,695	10,292	Netherlands 6,425; Belgium-Luxembourg 1,217; France 736; U.S.S.R. 659.
Distillate fuel oil ---do---	140,912	143,918	U.S.S.R. 24,790; Italy 14,002; France 9,191; Belgium-Luxembourg 8,586.
Residual fuel oil ---do---	26,507	31,042	Netherlands 16,510; France 4,182; Belgium-Luxembourg 1,785; Spain 1,126.
Lubricants ---do---	1,463	1,148	United Kingdom 231; France 224; Italy 168; Netherlands 168; United States 154.
Other:			
Mineral jelly and wax ---do---	1,346	952	Netherlands 150; France 87.
Unspecified ---do---	56,721	47,341	Netherlands 20,356; U.S.S.R. 3,150; Belgium-Luxembourg 2,863; France 2,093.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals thousand tons	784	694	Netherlands 290; France 111; Belgium-Luxembourg 74; United States 69.

r Revised. NA Not available.
1 Reported in 1975 as "ashes, residue, and scrap."

COMMODITY REVIEW

METALS

Aluminum.—Schweizerische Aluminium AG (Alusuisse) and Metallgesellschaft AG terminated their partnership in Leichtmetall-Gesellschaft mbH (LMG), Essen, leaving Alusuisse the sole owner of the company's reduction and processing plants.[4]

In 1976, West Germany's aluminum industry was running at full capacity, with stocks reduced substantially. Primary aluminum capacity of the country's plants was estimated at 748,000 tons per year; Germany was a net importer of primary and secondary aluminum and a net exporter of semifabricates. West Germany's principal supplier of aluminum metal was Norway, the main supplier of bauxite was Australia, and Surinam was the main source for alumina.[5]

German primary aluminum metal producers, with plant capacity in 1976, are shown in the following tabulation:

Company	Location	Yearend capacity (thousand tons)
Aluminium-Hütte Rheinfelden GmbH	Rheinfelden, Baden	50
Gebrüder Giulini GmbH	Ludwigshafen	45
Kaiser-Preussag Aluminium GmbH	Voerde, Duisburg	72
Leichtmetall-GmbH	Essen-Borbeck	130
Hamburger Aluminium-Werke GmbH	Hamburg	100
Vereinigte Aluminium-Werke AG	Erftwerk, Grevenbroich	36
Do	Innwerke, Töging	55
Do	Lippenwerke, Lünen	50
Do	Norf, Rheinwerke	145
Do	Elbewerk, Stade	65
Total		748

Iron Ore.—In 1976, Stahlwerke Peine-Salzgitter AG closed its 500,000-ton-per-year Bülten-Adenstedt mine, located south of Peine. The company also took over from Salzbergbau AG the Haverlahwiese and Konrad iron ore mines near Salzgitter. Eisenwerk-Gesellschaft Maximilianshütte mbH (Maxhütte) continued the development of the new Leonie mine near Sulzbach-Rosenberg, east of Nuremberg. In 1976, Germany's dwindling domestic iron ore supply was controlled by three companies operating seven mines. The mines supplied only a negligible fraction of Germany's iron ore requirements.

Iron and Steel.—Hopes for the recovery of West Germany's steel industry in 1976 faded by yearend, with a marked falloff of business during the winter. To improve the situation, steel companies were discussing large-scale mergers,[6] and there was a proposal for massive Government aid for German steel mills.[7] There were several important developments during the year. Klöckner-Werke AG took over the largest south German steel mill, Maxhütte, at Sulzbach-Rosenberg, from its present owner, the Düsseldorf-based Flick group, making it the country's third largest producer, with a 6.5-million-ton capacity. The Saar region's three mills have also been considering a closer cooperation for some time.[8]

Several investment projects started before the steel slump were completed. Maxhütte reconstructed its steelworks with new 60-ton converters. Gutehoffnungshütte Sterkrade AG commissioned a 7,000-ton-per-day blast furnace. Fried. Krupp Hüttenwerke AG commissioned at its Rheinhausen works two 300-ton basic oxygen converters and continuous-casting machines. All new metallurgical plants commissioned in West Germany were equipped with modern dust collectors. A go-ahead was given to replace existing open hearth furnaces at the Thyssen AG's Oberhausen plant with a new electric melting shop.

West Germany's major steel producers and their approximate steelmaking capac-

[4] U.S. Consulate, Düsseldorf, West Germany. State Department Airgram A-24, Feb. 11, 1977, p. 3.
[5] U.S. Consulate, Düsseldorf, West Germany. State Department Airgram A-80, May 6, 1977, pp. 1, 3.
[6] Der Spiegel (Hamburg, West Germany). Mar. 28, 1977, pp. 101-102.
[7] U.S. Consulate, Düsseldorf, West Germany. State Department Telegram 1509, Sept. 29, 1977.
[8] U.S. Consulate, Düsseldorf, West Germany. State Department Airgram A-127, Aug. 26, 1976.

ities in 1976 are shown in the following tabulation:

Company	Approximate steelmaking capacity (million tons per year)
Thyssen AG	15
Hoesch AG	7
Klöckner-Werke AG	6.5
Peine-Salzgitter AG	3.5
Fried. Krupp GmbH	3.5
Mannesmann AG	2.5
Stahlwerke Röchling-Burbach GmbH	2.1
AG der Dillinger Hüttenwerke	1.8
Neunkircher Eisenwerk AG	1.3

Lead and Zinc.—In 1976, prospecting for lead-zinc-copper deposits was continued in the Eifel Mountains, mainly by the mining companies themselves but also together with the Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources).

During 1976, mine production of lead and zinc decreased slightly; the ores mined assayed a total of 7.5% lead and zinc. Domestic mines supplied about one-eighth of the country's lead and one-third of its zinc requirements. Three West German companies operated four lead-zinc mines and five beneficiation plants in 1976.

NONMETALS

Cement.—In 1976, production of cement increased only slightly as industrial activity remained restrained. Investment funds were used solely for the replacement of old equipment or the rationalization of plants.[9] Sixty-one West German companies continued to operate the country's 86 cement plants.

Fertilizer Materials.— *Nitrogen.*—Nitrogen production decreased further in 1976. Ammonia production capacity was about 2.61 million tons in 1976. Companies engaged in the production of ammonia, with their plants and capacity, are shown in the following tabulation:

Company	Plant	Approximate capacity (thousand tons per year)
Badische Anilin und Soda Fabrik AG (BASF)	Ludwigshafen	800,000
Erdölchemie GmbH (Bayer AG, The British Petroleum Co. Ltd.)	Cologne	300,000
Gewerkeschaft Viktor Chemische Werke	Castrop Rauxel	250,000
Hoechst AG	Frankfurt	115,000
Rheinische Braunkohlenwerke AG	Wesseling	[1] 360,000
VEBA-Chemie AG	Bottrop	145,000
Do	Herne	240,000
Do	Gelsenkirchen-Scholven	400,000
Do	Brunsbüttel	[2] 400,000

[1] In planning stage.
[2] Startup in 1978.

Source: Petroleum Times, v. 81, No. 2060, Sept. 30, 1977, pp. 51–53.

Potash.—In 1976, West Germany's potash industry was again strongly affected by depressed activity in domestic or foreign markets. Both Kali und Salz AG and Kali-Chemie AG had to go on short working schedules.

Two companies operated West Germany's 12 potash mines. The largest among them was Kali and Salz AG, producing almost nine-tenths of the country's output and operating 10 potash mines (Bergmannssegen-Hugo, Hattorf, Neuhof-Ellers, Ronnenberg, Niedersachsen-Riedel, Salzdetfurth, Siegfried-Giesen, Sigmundshall, Hope, and Wintershall). Kali-Chemie AG, the second largest company, operated the Friedrichshall and Glückauf-Sarstedt mines. All these mines are in the Hannover area except Wintershall and Hattorf, which are east of Kassel on the East German border, and Neuhof-Ellers, located near Fulda.

Salt.—In 1976, West German rock salt sales had to be reduced to 8.5 million tons of common salt sales. Present West German salt capacity is about 13 million tons per year.[10] The country's major salt-producing areas were near Hannover (Lower Sax-

[9] Polysius AG (Neubeckum). Annual Report 1976. P. 5.
[10] Industrial Minerals. March 1977, p. 19.

ony), Borth (near Dortmund), and Heilbronn (north of Stuttgart). The largest mine, located at Borth, was owned by the Deutsche Solvay Werke GmbH (Solvay & Cie. S.A., Belgium) and had a capacity of about 4 million tons per year. Capacity at operations located in the Heilbronn salt deposit by Südwestdeutsche Salzwerke AG was about 5 million tons from four mines, and by Wacker Chemie GmbH, about 0.8 million tons. That of Kali und Salz was 2 million tons in Lower Saxony. Vacuum salt capacity of less than 1 million tons was divided mainly between Bayerische Berg-, Hütten- und Salzwerke AG (Stade), and Norddeutsche Salinen GmbH (Lüneburg). Some solution mining took place at Solvay's Borth, Heilbronn, and Epe mines. The solution from Epe, located on the Dutch border, is transported by pipeline to chemical plants near the Sambre River in Belgium.

Sulfur.—Davy Power Gas GmbH was to supply the technology for a secondary sulfur recovery plant at Ammoniawerk Brunsbüttel with a capacity of 22,000 tons per year of sulfur. Increased emphasis on environmental factors has resulted in a surge in the construction of secondary sulfur recovery plants.

Other Nonmetals.—Total fluorspar output increased at the country's approximately 13 fluorspar mines, located mainly in Baden-Württemberg and the Oberpfalz. Production covered nearly all domestic consumption requirements. Sales of barite decreased further, and more mines were closed in Rheinland-Palatinate and Bavaria, leaving only about seven producing mines in Lower Saxony, North Rhine Westphalia, and Baden-Württemberg. The largest barite producer was Sachtleben Bergbau GmbH, with mines at Dreislar and Meggen in North Rhine Westphalia and Wolfach in Baden-Württemberg.

MINERAL FUELS

Domestic coal and lignite, natural gas, and crude oil supplied 40% of West Germany's energy requirements. Imported petroleum accounted for most of the remaining portion, with some imported natural gas and nuclear fuel accounting for the rest.

The West German Government approved the basic guidelines of a revised energy program in 1976. The guidelines emphasized the importance of nuclear energy to close the energy gap but projected a total output of 30,000 megawatts (13% of the total) in 1986 instead of 45,000 to 50,000 megawatts; the importance of coal was also emphasized. The share of oil in domestic consumption would be reduced from 52% to 45%. Primary energy consumption was to increase at a rate of 3.6% per year to reach 500 million tons of standard coal equivalent in 1985. The plan also contained a number of energy conservation measures, mainly in the private sectors, such as housing.

Supply and apparent consumption of fuel and power in 1975 and 1976 are shown in table 5.

Coal.—In 1976, bituminous coal production decreased again as demand remained depressed during the slow recovery of the economy. Stocks of bituminous coal and coke grew to 21 million tons by yearend, although 10 million tons were absorbed by the Federal stockpile. Only the electric power industry increased coal consumption, from 23.3 million to 30.3 million tons, encouraged by Government subsidies.

West German lignite production increased in 1976, owing mainly to the use of new 200,000-cubic-meter-per-day bucketwheel excavators, installed by the Rheinische Braunkohlenwerke AG, the major producer, at its mines located in the Rheinland.

By yearend, employment in the bituminous coal industry had reached almost 200,000 while employment in the lignite industry just exceeded 20,000.

There were a number of important events in the coal industry of West Germany in 1976. In line with its 1974 Revised Energy Program and as part of a set of measures to relieve the depressed bituminous coal industry, the Federal Government decided to advance the creation of a national bituminous coal reserve from 1977 to 1976, and to assume the cost of interest as of January 1, 1976. It was estimated that these measures would bring approximately $700 million of extra liquidity to the coal industry by yearend 1977.[11]

Ruhrkohle AG underwent a reorganization when the company's Western, Central, and Eastern mines, operated by six subsidiaries, were consolidated under only three newly formed subsidiaries. Ruhrkohle

[11] U.S. Embassy, Bonn, West Germany. State Department Airgram A-240, Aug. 11, 1976.

Table 5.—Federal Republic of Germany: Supply and apparent consumption of fuels and power for 1975 and 1976

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke [2]	Petroleum and refinery products	Natural gas	Fuelwood and peat	Hydroelectric power	Nuclear power [3]	Other [4]
1975:								
Production [5]	161.0	125.7	8.5	19.6	0.5	5.5	--	1.2
Imports	239.0	7.3	189.2	30.5	--	e 5.0	7.0	--
Exports	57.6	22.1	31.9	.1	--	e 3.5	--	--
Apparent consumption	342.4	110.9	165.8	50.0	.5	7.0	7.0	1.2
1976:								
Production [5]	160.8	125.9	8.0	21.2	.4	4.1	--	1.2
Imports	258.5	10.0	205.3	31.1	--	4.2	7.9	--
Exports	38.7	21.3	13.4	.1	--	3.9	--	--
Apparent consumption	380.6	114.6	199.9	52.2	.4	4.4	7.9	1.2

e Estimate.
[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Includes lignite.
[3] Produced domestically from imported nuclear fuel.
[4] Includes solid waste, refuse, waste heat, and steam for generating power.
[5] Includes only primary energy.

Source: Verlag Glückauf (Essen). Jahrbuch für Bergbau, Energie, Mineralöl und Chemie, 1977/78. V. 85, p. 910.

also reported the discovery of a coal deposit containing more than 450 million tons of coking coal 7 miles northwest of Bottrop in the western part of the Ruhr.[12]

Saarbergwerke AG opened up 150 million tons of new coal by commissioning an $80 million mine at Warndt (Saar); the company also decided to invest $1.5 billion by 1981. About one-fifth of this amount was allotted to the mines, one-third was earmarked for a 700-megawatt extension of a thermal powerplant, and the rest was to be used for financial investments; environmental aspects of all investments were strongly emphasized. One new 650-megawatt section of the company's thermal powerplant came on-line; the unit was built with Government aid as part of the national 6,000-megawatt expansion program.

Work continued on development of Rheinische Braunkohlenwerke's Hambach lignite mine, located between Aachen and Cologne, which has reserves of about 2.4 billion tons. In the 1980's, the company's mines at Ville, Frechen, and Fortuna will be depleted, and development of the new mines was necessary to maintain production (Rheinbraun produced 118 million tons in 1976). In the process, up to 10,000 village and farm inhabitants are to be moved to new homes.

In an attempt to increase domestic bituminous coal consumption, coal gasification received a new boost when Ruhrkohle AG, Ruhrgas AG, and Steag AG agreed to build a 150-ton-per-day, $50 million experimental plant at Dorsten (north of Essen) to test bituminous coal gasification using the Lurgi process; the plant was expected to be operational by 1978–79.

As a result of 2 year's negotiation between West and East Germany, minor temporary shifts in the countries' common border have been agreed upon, making it possible for the Braunschweigische Kohlen-Bergwerke to exploit an additional 15 million tons of lignite located on the East German border near Helmstedt.

In 1976, there were 46 coal mines, 25 coking plants, 6 briqueting plants, and 31 coal-fired powerplants in West Germany's bituminous coal industry. The industry was controlled mainly by seven companies: Three in the Ruhr, two in the Aachen area, and one each in Saarland and Lower Saxony. The largest industrial group was Ruhrkohle, controlling about three-quarters of the country's output.

The lignite industry was dominated by the Rheinische Braunkohlenwerke, accounting for almost four-fifths of total output, followed by Bayerische Braunkohlen-Industrie AG (6%) and Braunschweigische Kohlen-Bergwerke AG (3.5%); the remaining production came from four smaller companies.

[12] The Wall Street Journal. V. 439, No. 102, May 25, 1977, p. 10.

Petroleum and Natural Gas.—With demand rebounding vigorously in 1976, West Germany remained Western Europe's largest consumer of crude oil and petroleum products, accounting for 138 million tons, or more than one-fifth of Europe's total crude oil consumption.[13]

Shrinking domestic crude oil production supplied only an unimportant 4% of demand. However, natural gas production expanded slightly, to 65% of the domestic natural gas supply. Secondary and tertiary recovery measures were used to slow down the decrease in domestic oil production. Exploratory drilling totaled 235 kilometers in 1976. A total of 22 offshore wells were drilled in the West German sector without making any commercial discoveries. On January 1, 1977, reserves of crude oil were 70.3 million tons (about 500 million barrels), of which 44.4 million (300 million barrels) were proven reserves; the rest consisted of possible reserves. Natural gas reserves were calculated at 296 billion cubic meters, of which 208.6 billion were proven reserves.[14]

Imports of crude oil and petroleum products exceeded 140 million tons in 1976. The oil originated mainly in the Middle East, with Libya, Iran, and Saudi Arabia each supplying one-fifth of the total. Norway, the United Kingdom and Denmark figured for the first time on the list of 22 suppliers.

About 83 million tons of the crude oil was imported through five pipelines: The Wilhelmshaven-Rheine (NWO); Trieste-Ingolstadt-Karlsruhe (TAL); Marseilles-Karlsruhe, Woerth, Speyer-Saarbrücken (SEPL); Rotterdam-Rhine (RRP); and Geneva-Ingolstadt (CEL).

There were 64 caverns in salt domes at nine locations for storage of petroleum with 9.5 million tons of oil stored at yearend 1976.

Natural gas imports came mainly from the Netherlands and from the U.S.S.R. through Czechoslovakia, Austria, or Switzerland.

Petroleum refining was little changed compared with that of 1975, as excess refinery capacity and an increase in the compulsory storage of stocks burdened oil companies. Total West German refining capacity remained a nominal 153.9 million tons.[15] Twenty-two companies controlled 33 domestic oil refineries. The largest among them was Government-owned VEBA, with nearly half of the country's refining capacity.

Uranium.—In 1976, West Germany remained a small producer of uranium with five active companies: (1) Esso-Erz GmbH was prospecting in West Germany and found a potential deposit in the Upper Pfalz; (2) Gewerkschaft Brunhilde had a 150-ton-per-year U_3O_8 plant at Birkenfeld (Nahe) southeast of Trier, processing domestic and imported French ores and doing some domestic prospecting; (3) Uranerzbergbau GmbH was prospecting in Germany, Austria, and Switzerland and had operating facilities in Canada in partnership with Canadian companies; (4) Urangesellschaft mbH & Co. KG was exploring and operating worldwide to secure uranium reserves for West Germany; and (5) Saarberg-Interplan GmbH was exploring for uranium in West Germany and discovered at Müllenbach in the Murg Valley (Black Forest) reserves of 1,500 tons of ore containing 0.2% to 1.3% U_3O_8.[16]

The bulk of the uranium used in West Germany was imported as processed nuclear fuel from the United States, the U.S.S.R., and France. West Germany's nuclear construction industry was strongly export oriented and competitive on the world market. The country's present nuclear power program includes 10 operating plants with a total capacity of 3,494 megawatts, 13 plants under construction with an installed capacity of 13,330 kilowatts, 8 reactors in the planning stage with 9,219 megawatts' installed capacity, a further 6 plants totaling 7,800 megawatts under consideration, and 5 reactor sites under preliminary consideration.

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[13] U.S. Consulate, Hamburg, West Germany. State Department Airgram A–14, July 29, 1977.
[14] U.S. Embassy, Bonn, West Germany. State Department Airgram A–213, June 22, 1977, p. 1.
[15] U.S. Consulate General, Hamburg, West Germany. State Department Airgram A–14, July 29, 1977.
[16] ATW News (Düsseldorf). No. 7, July 1977, p. 1.

The Mineral Industry of Ghana

By Janice L. W. Jolly [1]

The 1976 mineral industry of Ghana consisted of bauxite, diamond, gold, manganese ore, and salt mining and also included production of cement from imported clinker, aluminum from imported alumina, and petroleum products from imported crude oil. Gold production increased slightly over 1975, but manganese, diamond, and bauxite production were down. Most major exports declined in 1976 and prices paid for imports rose sharply, necessitating governmental action to conserve foreign exchange.

The effective date for minimum Ghanaian participation, under the Investment Policy Decree of 1975, was extended to December 31, 1976, to give more time for Ghanaians to become familiar with the implications of shareholding and to enable the Investment Policy Implementation Commission (IPIC) to work more effectively. Firms affected by the Investment Policy Decree in the meantime continued to float their shares. The State, or Ghanaian individuals, must hold from 20% to 55% in all enterprises. The share specified in each varied as determined by the National Redemption Council. A new income tax decree was also published which consolidates and codifies the Income Tax Decree of 1966 and later amendments. The company tax rate of 65% was to remain unchanged, but small Ghanaian companies whose turnover did not exceed $175,000 [2] were to pay higher rates of tax in the first 5 years of operation.[3]

The Government's ordinary budget for 1976–77 was set at $771.3 million, an increase of 15% over the preceding budget. The development budget was about $313 million. Loans for completing the Kpong dam and hydroelectric power project were secured. Construction on the $280 million project was expected to start by July 1977. Loans were derived from the European Development Fund ($9.7 million), the European Investment Bank ($10.9 million), the Saudi Arabian Fund for Development ($30 million), and the Canadian International Development Agency (CIDA) ($35 million). The Federal Republic of Germany also agreed to loan $22.8 million for the financing of development projects including electrical expansion. An agreement was reached with Acres International Ltd. of Canada to undertake the consulting engineering services and supervision of the Kpong hydroelectric project construction. Five foreign firms had submitted bids to construct the dam, including Sweden, Italy, West Germany, and France.[4]

The World Bank was to loan $18 million to the Electrical Corp. of Ghana for supply of power and extension to existing plants in the Western Ashanti and Greater Accra regions. This was to include reinforcement of the existing Tema, Accra, and Kumasi networks and extension of power to the Subin gold mines, the Bibiani metal complex, the Awaso bauxite mines, and the Aboso glass factory.[5] The International Development Association (IDA) was to loan $10 million for road improvements. The Ghanaian Government started construction of 106 kilometers of principal roads aided by Italian engineers from Siteco Fiat.

The Government has reactivated the atomic reactor project originally started

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from the Ghana new cedi (N¢) to U.S. dollars at the rate of N¢1=US$0.8696.

[3] Standard and Chartered Review, London. Ghana. March 1976, p. 32.

[4] Standard and Chartered Review, London. Ghana. March 1977, p. 38.

[5] Standard and Chartered Review, London. Ghana. February 1977, p. 40.

with the U.S.S.R. but abandoned after the 1966 coup. The project was considered necessary to permit the country to accelerate development. The atomic reactor, to be situated at Kwabenya, was expected to be operating in about 3 years. The Commission of Atomic Energy was also studying the utilization of solar energy. The second African meeting on energy was held in late 1976 in Accra, Ghana. The purpose was to appraise the current and future energy situation and prospects in the continent; to analyze the trends and energy resources, supplies and marketing, and the development of indigenous sources of energy at all levels; to consider cooperation among member States in the field of energy; to exchange information on the latest advances and research in energy; to consider the possibilities of training technical personnel in energy fields; and to formulate and coordinate energy policies of member States. One of the key developments was the establishment of a group to study the founding of an African energy bank to finance the necessary investments. Plans were also formulated for an information agency to disseminate energy resource data.[6]

PRODUCTION AND TRADE

In 1976, Ghana National Manganese Corp. shipped 384,752 tons of manganese ore to Belgium, Czechoslovakia, Finland, the Netherlands, Ireland, Italy, Japan, Norway, Portugal, Spain, the United Kingdom, West Germany, and Yugoslavia.[7] By comparison, 355,300 tons of ore were exported in 1975. Bauxite exports in 1975 were 320,495 tons and went mainly to British Aluminium Co., Ltd., in the United Kingdom. Exports are apparently limited by the poor condition of the railroad from the mine to the Port of Takoradi.

Among the imports that rose sharply in the first part of 1976 were petroleum and cement clinker. At the same time, major export items were declining sharply. In the first 4 months of 1976, gold exports slumped to $15 million from $27 million for the same period in 1975. Gold production was down to 301,794 ounces in the first 6 months of 1976 compared with 306,731 ounces for the same 1975 period.

Ghana Supply Commission imported 9.4 million barrels of crude oil in 1976 from the U.S.S.R. (700,000 barrels), Nigeria (6.3 million barrels), and Libya (2.4 million barrels). The Ghana Commissioner for Foreign Affairs appealed to the Organization of Petroleum Exporting Countries (OPEC) to exercise moderation in oil price increases for 1976 in view of problems that oil prices have created in Africa, adding that further increases would jeopardize the economies of developing countries.

On August 25, 1976, the Government issued a decree establishing a National Procurement Agency for bulk purchasing and for the distribution of selected consumer goods and raw materials for manufacturing. Cement clinker, scrap iron, and fertilizers were included products. The Special Unnumbered Import Licenses (SUL) were also reintroduced allowing financing of imports by private businesses using their own private sources of foreign exchange. The reintroduction of SUL's was apparently the result of pressure on the country's foreign exchange resources resulting from a deteriorating trade balance. All exports of manganese ore, bauxite, and ores or concentrates of nonferrous base metals were to be made under the supervision of the General Superintendent Co. Ltd. in Accra. This organization also was to have authority to inspect ore shipments at the cargo's seaport destinations. Ore exporters were required to give the company signed copies of ore sales contracts with overseas buyers, shipping contracts, and details of shipments.

The U.S.S.R. and Ghana signed a new 5-year trade agreement to replace the long-term trade and payment agreement made between the two countries in 1961.[8] The agreement provided for the payment in convertible currency for all goods exchanged between the two countries. Ghana's main imports from the U.S.S.R. were crude oil and iron rods, while the U.S.S.R. imported cocoa and timber from Ghana. A bilateral trade agreement was also signed with the Ivory Coast and Cameroon.

[6] To the Point International, Brussels. Solar, Geothermal, Nuclear, Hydro—Africa Turns to Its Own Energy. Jan. 24, 1977, p. 26.
[7] Skillings Mining Review. Ghana National Exports Manganese Ore in 1976. V. 66, No. 9, Feb. 26, 1977, p. 15.
[8] Standard and Chartered Review, London. Ghana. December 1976, p. 32.

Table 1.—Ghana: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
METALS				
Aluminum:				
Bauxite, gross weight		363,129	319,526	271,563
Metal, smelter production, primary		157,198	143,220	151,391
Gold	thousand troy ounces	567	524	532
Manganese ore and concentrate, gross weight		250,253	370,805	311,872
NONMETALS				
Cement	thousand tons	521	688	[e] 700
Diamond:				
Gem	thousand carats	257	233	228
Industrial	do	[r] 2,315	2,095	2,055
Total	do	[r] 2,572	2,328	2,283
Salt		52,000	[e] 60,000	[e] 60,000
MINERAL FUELS AND RELATED MATERIALS				
Petroleum refinery products:				
Gasoline	thousand 42-gallon barrels	1,967	2,154	NA
Jet fuel	do	318	364	
Kerosine	do	743	795	
Distillate fuel oil	do	2,382	2,549	
Residual fuel oil	do	2,606	2,811	
Other	do	62	--	
Refinery fuel and losses	do	418	445	
Total	do	8,496	9,118	NA

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, a variety of crude construction materials (clays, sand, gravel, and stone) is produced, but production data are not reported and available information is inadequate for the formulation of reliable estimates of output levels.

Table 2.—Ghana: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite and concentrate	[r] 398,318	320,495	United Kingdom 209,873; Netherlands 96,640.
Metal including alloys, unwrought and semimanufactures	[r] 84,135	65,810	United States 27,508; Argentina 11,086.
Copper metal including alloys, all forms	--	11	All to Nigeria.
Gold bullion, thousand troy ounces	696	513	Switzerland 486.
Iron and steel metal including alloys, all forms	[r] 4,026	245	Netherlands 238.
Manganese ore and concentrate	[r] 280,502	372,904	Spain 88,561; Norway 64,321; Japan 51,931.
Platinum-group metals and silver, troy ounces	541	--	
Other nonferrous metal, scrap, n.e.s	[r] 1,284	276	West Germany 118; Belgium-Luxembourg 97.
NONMETALS			
Cement	[r] 498	5,986	Niger 4,761; Upper Volta 1,224.
Clays and clay products, including refractory brick	--	8	Niger 6; United Kingdom 2.
Diamond, all grades, thousand carats	2,556	2,372	United Kingdom 1,310; Netherlands 488; Belgium-Luxembourg 460.
Salt	1,474	15,106	Upper Volta 14,948.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline, thousand 42-gallon barrels	(1)	22	All to Nigeria.
Kerosine and jet fuel, do	1	18	Nigeria 15; United Kingdom 3.
Distillate fuel oil, do	287	347	Italy 285; Nigeria 61.
Residual fuel oil, do	[r] 1,815	2,151	United States 2,010.
Lubricants, do	(1)	(1)	All to Italy and United States.
Total, do	[r] 2,103	2,538	

[r] Revised.

[1] Less than ½ unit.

Table 3.—Ghana: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Oxide and hydroxide	327,136	273,801
Metal, unwrought and semimanufactures	r 4,864	3,691
Copper metal including alloys, all forms	r 1,389	972
Iron and steel including alloys, all forms	138,162	342,386
Lead metal including alloys, all forms	r 387	541
Platinum-group metals, including silver ---troy ounces	102,408	12,347
Tin metal including alloys, all forms	182	238
Zinc metal including alloys, all forms	550	448
Other:		
Ore and concentrate	r 90	33
Scrap	(1)	27
Metal including alloys	r 1,209	1,534
Oxides, hydroxides, and peroxides of metals, n.e.s	r 1,587	849
NONMETALS		
Abrasives, natural:		
Pumice, emery, dust and powder ---value	$9,155	$15,448
Grinding and polishing wheels and stones	1,478	882
Asbestos	21,613	13,188
Cement:		
Clinker	500,107	837,426
Portland	16,676	16,716
Clays and clay products (including refractory brick):		
Clays, crude	552	320
Products	3,982	12,033
Diamond, industrial ---carats	--	144
Fertilizer materials, all types	4,925	3,948
Gypsum and plasters	r 17,502	16,590
Lime	4,138	3,105
Pyrite	279	493
Salt and brine	590	93
Sodium and potassium compounds, caustic soda	r 9,530	6,062
Stone, sand and gravel	r 1,151	1,312
Sulfur, sulfuric acid	894	301
Talc	1,389	489
Other, crude [2]	r 1,182	2,780
Building materials of asphalt, asbestos, and fiber cement, including unfired clay brick	1,920	874
MINERAL FUELS AND RELATED MATERIALS		
Asphalt, natural	39	55
Coal and coke, including briquets	6,203	10,341
Hydrogen, helium, and rare gases	r 125	200
Petroleum:		
Crude and partly refined ---thousand 42-gallon barrels	8,246	8,567
Refinery products ---do	r 853	940
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	128	999

r Revised.
[1] Less than ½ unit.
[2] Includes mica, amber, meerschaum, jet, chalk, and other unspecified nonmetals.

COMMODITY REVIEW

METALS

Aluminum.—The $65 million addition of a fifth potline to the Volta Aluminium Co. Ltd.'s (VALCO) smelter at Tema was reported as 50% complete at the beginning of 1976. The smelter's capacity was to be raised to 198,000 tons by late 1976.

The Government was anxious to continue development studies of the Kibi and Nyanihin bauxite deposits. The Aluminium Resources Development Co. of Tokyo withdrew from the Kibi bauxite development program because of unfavorable world market conditions. Kaiser Aluminum and Chemical Corp. of the United States was maintaining its interest in the project and continuing exploitation studies. The Ghana Commission of Aluminum Industries had allotted $434,800 for reviewing the feasibility studies.[9] New facilities would have to be built to move the bauxite to the port at Tema.

Ghana Bauxite Co. Ltd. (GBC), that operated Ghana's only bauxite mine near Awaso, was 55% owned by the Ghanaian Government and 45% by the British Aluminium Co., Ltd. The Government assumed its share of the control in 1974. There was no alumina production in Ghana. The aluminum smelter at Tema used imported alumina from the United States, Jamaica, and Australia. In 1975, bauxite reserves were estimated at 335 million tons and resources at 460 million tons.

Gold.—Gold production, cumulative to July 1976, totaled 301,794 troy ounces compared with 306,731 ounces for the same 1975 period.[10] Alluvial Dredges Ltd. was to supply the State Gold Mining Corp. (GMC) with two new dredges designed and equipped for gold recovery. The two dredges were to cost about $8 million and were the result of a second contract placed by GMC as a part of its long-term plan to revitalize the gold placer operations. Alluvial Dredges was in the final phase of completing the earlier contract for two dredges ordered in 1975.

The United Nations was undertaking a training program to last through 1977 for improving mining skills of Ghanaians of GMC. Part of the program included a fellowship training program in which Ghanaians were placed at selected mines in Zambia and the United States to learn modern, practical mining techniques on a firsthand basis.

Iron and Steel.—A second steel factory was to be constructed at Kumasi with a rolling mill of 30,000 tons per year.[11]

Manganese.—In 1974, Ghana acquired the entire holdings of the Nsuta manganese operations from the African Manganese Co., a subsidiary of Union Carbide Corp. The mine was now being operated by the Ghana National Manganese Corp. In a 1973 executive instrument, the Government had appointed Ghana National Manganese as its agent to purchase all ores mined at the Nsuta mine. Caemi International of the Netherlands was to serve as exclusive agent for manganese marketing.[12] Initial production results after the Ghana National Manganese takeover of the mine had improved by early 1975, and both recruitment and prospecting were reported as recommencing.[13] Ghana National Manganese Corp. was also undertaking construction of a concentrator to further treat low-grade minerals.[14] Some concentrated carbonate ore was reportedly shipped to Japan in 1976.

NONMETALS

Diamond.—Ghana Consolidated Diamonds Ltd. (GCDL) estimated the lower Birim River would yield another 50 million carats. The deposit was to be mined at the rate of 2 million carats per year. This new deposit was now to be exploited since the traditional Akwatia area in Akyem Abuakwa was expected to be phased out by 1980. The First International Natura Corp., a New York-based company, was negotiating with the Government for mining rights in a 63.6-square-kilometer area near the confluence of the Birim and Pra Rivers. The Government will hold a 55% share of the project. Preliminary prospecting had already been completed.

At yearend 1975, an increase in diamond prices was announced by the Diamond Marketing Corp. (DMC) according to size

[9] Industries et Travaux D'Outre-mer, Paris. Ghana. V. 24, No. 275, September 1976, p. 670.
[10] Standard and Chartered Review, London. Ghana. November 1976, p. 38.
[11] Page 660 of work cited in footnote 9.
[12] Mining Annual Review, London. West Africa. June 1974, p. 373.
[13] World Mining. Ghana. V. 29, No. 7, Jun. 25, 1976, p. 142.
[14] Industries et Travaux D'Outre-mer, Paris. Ghana. V. 24, No. 275, October 1976, p. 729.

and quality, but the effective overall increase was about 3%. An improvement in demand in the first quarter of 1976 was evident especially for larger diamonds with certain qualities. The DMC was grading, valuing, and processing diamonds as well as buying all those mined locally. All companies except GCDL sold directly to the DMC and received money directly from it. GCDL sold through the DMC instead of to it. Under the 1968 marketing arrangement, licensed dealers were to bid on "reserve prices" set by GCDL and the DMC. If the dealers' highest bid was below the higher of the two prices, the diamonds were sold to the DMC, which sold them overseas with assistance from Consolidated African Selection Trust Limited (CAST) in London.[15] CAST owned 45% of GCDL.

MINERAL FUELS

Petroleum.—Signal Exploration and Development Co., Amoco Ghana Exploration Co., Mobil Oil Ghana Ltd., and Zapata Exploration Co. were all prospecting for oil offshore Ghana. Shell (incorporated in Ghana as Shell Exploration and Production Co.) was operating onshore near Attebubu in the Brong-Ahafo region of the Voltaian Basin. The Commissioner of Lands and Mineral Resources announced new terms for liberalizing exploration agreements that would include duty-free importation of exploration equipment and guarantee of profit repatriation. Participation of oil companies, if necessary, might be up to 20% by the Government.

The Ghanaian Government completed negotiations for the takeover of the Ghanaian Italian Petroleum Co. Ltd. (GHAIP) refinery at Tema in 1975 and formed a new oil distributing company called Ghana Oil Co. The Ghana Supply Commission was sole oil importer and agent for the refinery. The Government of Ghana authorized the Ghana Supply Commission to construct an asphalt plant costing $8.7 million near the Tema refinery. The construction was to take place at the beginning of 1977.[16] Mobil Oil was projecting the creation of a lubricant factory to help cut down on imports.

[15] U.S. Embassy, Accra, Ghana. State Department Airgram A-31, Apr. 18, 1975, 4 pp.

[16] Industries et Travaux D'Outre-mer, Paris. Ghana. V. 24, No. 266, January 1976, p. 60.

The Mineral Industry of Greece[1]

By Roman V. Sondermayer [2]

Bauxite and various nonmetals were the main mineral commodities of Greece during 1976, and efforts continued to develop new mineral resources. The most important minerals produced were magnesite, pumice, bauxite, alumina, barite, lignite, nickel, perlite, pyrite, and aluminum. Output of other mineral commodities was of only domestic significance.

The year was mixed for the Greek mineral industry, reflecting the recession in major industrialized countries, Greece's uneven economic performance, and price fluctuations on international commodity markets.

The mineral industry was privately owned, but the Government was organizing publicly owned corporations. The Ministry of Industry regulated activities and collected statistics. In addition, the Greek Government continued to stimulate development of the mineral sector, enacted new legislation, and reorganized Government institutions involved in the mineral industry. The Government has assumed a leading role in mineral exploration. The three major Government agencies involved in the mineral industry's activities were the Institute of Geological and Mineral Research (IGME), the Public Power Corp. (PPC), and the Public Petroleum Co. (DEP). The Project Studies and Mining Corporation (GEMEE), a mining company controlled by the Hellenic Industrial Development Bank (ETVA), was reactivated to assist in development of ETVA/Government-controlled mines.

The mineral industry contributed an estimated 7% to the gross national product (GNP). However, the extractive industry's share was only 1.3%. Employment in the mineral industry was estimated at 18,000 persons.

Major events in the mineral industry in 1976 were as follows: Planning for a new 600,000-ton-per-year alumina plant; exploration for chromite and increasing the capacity of existing chromite mines and beneficiation plants; the opening of a new complex lead-zinc-pyrite ore mine at Olimpias; approval by the Government of expansion of Société Minière et Métallurgique de Larymna S.A.'s (LARCO) nickel mines and smelter; completion of two cement plants; completion of several facilities for processing magnesite; the first discovery of phosphate rock at Delvinákion; development of lignite deposits at Ptolemaïs and Megalópolis; and continuation of exploratory drilling for petroleum and natural gas in northern Greece.

PRODUCTION

Mineral-producing facilities varied greatly in regard to size, mechanization, and efficiency. As a rule, petroleum-processing facilities were modern and efficient. Metal mining and processing had some outdated operations, and productivity was low compared with that of other European countries. The following tabulation shows major companies and facilities in Greece during 1976:

[1] A principal source of information for this chapter was: U.S. Embassy, Athens, Greece. Industrial Outlook Report, Minerals—1976, drafted by D. Kirkini and R. L. Jackson. State Department Airgram A-16, Jan. 31, 1977.

[2] Physical scientist, International Data and Analysis.

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	Aluminium de Grèce S.A. (AG), plant at Distomon (Boeotia), Péchiney Ugine Kuhlmann (PUK) 73% and Government 27%.	100
Barite	Mykobar Mining Co., mines on Mílos Island, Dresser Industries, Inc. (United States).	50
Bauxite	Bauxites Parnasse Mining Co., mines at Parnassós-Ghiona	51
Cement	Chalkis Cement Co. S.A., plants at Chalkis	40
Chromite	A. E. Chrome Mine Co. Ltd., mines at Vólos, Kozáni, and Lamia, Scalistiri Group.	50
Lead and zinc	Compagnie Française des Mines du Laurium, mine and smelter at Laurium, Peñarroya S.A. 66.5%.	50
Lignite	Public Power Corp., mines at Ptolemaïs and Megalópolis, Government.	98
Magnesite	Financial Mining-Industrial & Shopping Corp. (FIMISCO), mines at Euboea and Khalkidhikí, plant at Mantoudhi, Scalistiri Group.	70
Nickel	Société Minière et Métallurgique de Larymna S.A. (LARCO), smelter at Larymna, mines at Euboea and Boeotia, Bodosakis Group.	100
Perlite	Silver and Baryte Ores Mining Co., mines on Kos and Mílos Islands, AG.	80
Petroleum, refined	Motor Oil (Hellas) Corinth Refineries S.A., refinery at Corinth	34
Steel	Halyvourghiki S.A., works at Eleusis	75

Table 1.—Greece: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum:			
Bauxite, gross weight ---thousand tons	2,783	3,244	2,747
Alumina, gross weight ---do	498	459	450
Metal, primary	[r] 148,991	135,600	133,900
Antimony, mine output, metal content	501	426	[e] 450
Chromium, chromite:			
Crude ore, gross weight	12,813	73,823	66,723
Concentrate, gross weight	9,590	22,945	26,908
Copper, mine output, metal content	883	1,391	980
Iron and steel:			
Ore and concentrate, gross weight, nickeliferous [2] thousand tons	2,013	1,974	2,205
Pig iron and ferroalloys ---do	500	540	400
Crude steel ---do	[r] 687	1,000	[e] 800
Steel semimanufactures [3] ---do	963	NA	NA
Lead:			
Mine output, metal content	22,010	12,884	29,752
Metal, refined: [4]			
Primary	[r] 14,489	16,300	18,692
Secondary	11,675	14,333	[e] 16,000
Manganese:			
Crude ore, gross weight	52,091	45,248	58,248
Concentrate, gross weight [5]	[r] 7,950	11,318	10,924
Nickel:			
Mine output, nickeliferous iron ore, metal content [6]	28,692	28,136	27,561
Metal, content in alloys	[r] 15,059	14,826	16,448
Silver, smelter or refinery production ---thousand troy ounces	575	478	475
Zinc:			
Mine output, metal content	24,989	14,707	29,041
Metal, including secondary	137	[e] 100	[e] 150
NONMETALS			
Abrasives, natural, emery	6,775	7,000	6,500
Asbestos	[r] 1,780	[e] 2,000	[e] 2,000
Barite:			
Crude ore	165,164	173,091	90,620
Concentrate	93,272	106,608	60,764
Cement, hydraulic ---thousand tons	[r] 7,020	7,940	8,745
Clays:			
Bentonite:			
Crude	384,408	428,466	313,467
Processed	318,046	246,308	294,364
Kaolin:			
Crude	82,753	72,140	70,728
Processed	18,515	16,881	9,866

See footnotes at end of table.

Table 1.—Greece: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
NONMETALS—Continued				
Fertilizers, manufactured, gross weight:				
Nitrogenous	thousand tons	361	283	NA
Phosphatic	do	147	187	NA
Potassic	do	30	23	NA
Fluorspar		1,000	1,000	[e] 1,000
Gypsum and anhydrite		441,759	416,557	410,000
Magnesite:				
Crude	thousand tons	1,369	1,426	1,500
Deadburned		382,500	359,963	341,485
Caustic-calcined		76,745	56,281	70,364
Perlite:				
Crude		213,017	158,074	235,677
Screened		114,195	105,580	129,298
Pozzolan (Santorin earth)		820,735	857,944	848,213
Pumice		523,896	525,952	364,978
Pyrite, gross weight		255,414	188,257	180,368
Salt, all types	thousand tons	149	[r e] 150	140
Silica (probably silica sand)		17,997	16,165	16,866
Stone, marble	cubic meters	120,000	110,000	115,000
Sulfur, content of pyrite		114,936	84,716	81,166
Talc		4,320	5,860	[e] 6,000
MINERAL FUELS AND RELATED MATERIALS				
Coal, lignite	thousand tons	14,109	17,600	22,237
Coke:				
Coke-oven	do	372	421	[e] 360
Gashouse	do	12	11	[e] 10
Fuel briquets (lignite briquets)	do	89	90	NA
Gas, manufactured:				
Gas works	million cubic feet	320	NA	NA
Blast furnace	do	7,652	NA	NA
Coke ovens	do	6,811	NA	NA
Petroleum refinery products:				
Gasoline	thousand 42-gallon barrels	7,098	7,149	8,424
Jet fuel	do	2,384	5,152	4,728
Kerosine	do	302	372	395
Distillate fuel oil	do	22,111	21,932	19,918
Residual fuel oil	do	35,178	36,150	35,112
Lubricants	do	539	427	385
Other	do	9,250	10,164	8,523
Refinery fuel and losses	do	7,264	5,062	4,248
Total	do	84,126	86,408	81,733

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, other types of crude construction materials such as clays, sand and gravel, and stone are produced, but output is not reported and available information is inadequate for formulation of reliable estimates of output levels. Cobalt is also produced, but output is included with nickel.

[2] Nickel content is reported under nickel.

[3] Black sheet, galvanized sheet, reinforcing bars, and wire only.

[4] Includes antimonial lead and hard lead.

[5] Includes powdered manganese as follows, in tons: 1974—1,122, 1975—3,908, and 1976—4,194.

[6] Nickel plus contained cobalt.

TRADE

During 1975, the latest year for which complete data are available, imports of minerals and fuels were valued at $1.5 billion, or about 33% of the country's total imports. Fuels, mostly petroleum, accounted for $1 billion. Mineral exports, mostly bauxite, ferronickel, and nonmetals, were valued at $0.7 billion, or 34% of total exports. Tables 2 and 3 give trade statistics for selected commodities.

Table 2.—Greece: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite and concentrate --thousand tons--	1,457	1,595	U.S.S.R. 608; Romania 521; France 122.
Oxide and hydroxide	190,207	NA	
Metal including alloys:			
Unwrought, including scrap	102,465	89,072	France 37,541; Italy 19,591; Lebanon 14,531.
Semimanufactures	16,164	9,174	Italy 2,036; Iraq 1,401; Saudi Arabia 1,015.
Antimony ore and concentrate	158	NA	
Chromium, chromite	10,787	19,274	West Germany 10,700; Norway 7,524.
Copper:			
Matte	54	NA	
Metal including alloys:			
Scrap	162	NA	
Unwrought	174	47	NA.
Semimanufactures	2,938	2,414	France 677; Italy 423; West Germany 264.
Iron and steel:			
Roasted pyrite	21,200	19,804	West Germany 11,796.
Metal:			
Scrap	118	NA	
Ferroalloys, ferronickel	81,568	[1] 49,535	Sweden 20,169; West Germany 12,343; France 6,328.
Steel, primary forms	155,609	93,446	Spain 77,921; Italy 8,525; Syria 7,000.
Semimanufactures:			
Bars, rods, angles, shapes, sections	105,826	58,227	Libya 30,283; United States 10,500; Yugoslavia 5,149.
Universals, plates, sheets	131,003	107,670	Yugoslavia 80,744; Bulgaria 10,500; Syria 4,717.
Hoop and strip	17,895	3,678	Yugoslavia 3,297.
Wire	340	1,315	Libya 1,176.
Tubes, pipes, fittings	29,699	69,561	Nigeria 28,696; Indonesia 16,840; Libya 16,364.
Castings and forgings, rough	332	NA	
Lead:			
Ore and concentrate	28,480	12,988	Belgium-Luxembourg 4,000; Yugoslavia 3,911; Italy 2,440.
Metal including alloys, all forms	3,571	1,076	Egypt 840; Libya 120; France 112.
Manganese ore and concentrate	7,623	2,966	West Germany 2,590.
Silver metal including alloys thousand troy ounces--	547	(2)	All to France.
Zinc ore and concentrate	51,289	26,110	Italy 8,462; France 6,628; Spain 4,000.
Other:			
Ores and concentrate	[r] 8,600	6,350	Yugoslavia 3,350; France 1,850; Italy 1,000.
Ash and residue containing nonferrous metals	26,274	26,280	Netherlands 17,535; United Kingdom 7,340.
Waste and sweepings of precious metals	26	NA	
NONMETALS			
Abrasives, natural, n.e.s.: Pumice, emery, natural corundum, etc	270,287	NA	
Barite and witherite	101,811	NA	
Cement --thousand tons--	1,942	2,831	Libya 1,661; Nigeria 585; Algeria 313.
Clays and clay products (including all refractory brick):			
Crude	364,097	NA	
Products:			
Refractory (including nonclay bricks)	29,649	25,048	West Germany 9,627; Sweden 4,248; France 2,466.
Nonrefractory	[r] 25,132	15,998	Yugoslavia 4,834; Libya 4,779; U.S.S.R. 1,832.
Fertilizer materials, manufactured:			
Nitrogenous	13,300	18,458	Egypt 11,500; Cyprus 6,958.
Phosphatic	8,770	5,250	All to Pakistan.
Other, including mixed	6,332	4,994	All to Cyprus.

See footnotes at end of table.

Table 2.—Greece: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Gypsum and plasters	5,168	NA	
Lime	36,603	33,269	Libya 32,738.
Magnesite	437,392	NA	
Mica, crude, including splittings and waste	4,722	NA	
Sodium and potassium compounds, n.e.s.:			
Caustic soda	206	NA	
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked, calcareous	35,419	NA	
Worked	34,074	51,783	Libya 45,207.
Gravel and crushed rock, n.e.s	32,974	NA	
Quartz and quartzite	4,000	NA	
Sulfur:			
Elemental, other than colloidal	10,125	10,021	Turkey 4,617; Egypt 3,000; Cyprus 1,200.
Sulfuric acid	35,724	9,188	Turkey 4,948; Romania 2,979.
Other:			
Crude	r 168,232	[3] 253,208	West Germany 57,480; United States 44,057; France 28,882.
Slag, dross, and similar waste, not metal bearing	2,018	7,999	NA.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	46,625	54,915	Libya 15,008; Iraq 9,293; Hungary 6,684.
MINERAL FUELS AND RELATED MATERIALS			
Coal	26,597	--	
Coke and semicoke	41,611	27,216	Spain 16,499; Liberia 5,496; Romania 5,221.
Petroleum refinery products:			
Gasoline, motor thousand 42-gallon barrels	r 3,504	6,070	United Kingdom 2,629; Netherlands 1,546; France 1,009.
Kerosine and jet fuel ---do---	r 1,201	2,882	Tunisia 596; United States 548; Lebanon 408.
Distillate fuel oil ---do---	r 2,416	4,872	Syria 1,200; West Germany 1,018; Tunisia 595.
Residual fuel oil ---do---	4,740	6,379	Italy 3,625; Liberia 573; Denmark 350.
Lubricants ---do---	414	179	United Kingdom 33; Spain 21; Italy 20.
Liquefied petroleum gas ---do---	48	254	Tunisia 121; Turkey 45; Lebanon 36.

r Revised. NA Not available.
[1] Includes pig iron and other ferroalloys, if any.
[2] Value reported at $932,000.
[3] Includes barite and witherite.

Table 3.—Greece: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite and concentrate	--	976
Metal including alloys:		
Scrap	325	NA
Unwrought	1,767	891
Semimanufactures	r 2,239	1,800
Antimony metal including alloys, all forms	--	NA
Chromium:		
Chromite	--	1,146
Oxide and hydroxide	121	NA
Copper:		
Matte	--	NA
Copper sulfate	1,458	NA
Metal including alloys:		
Scrap	120	310
Unwrought	15,236	24,710
Semimanufactures	1,184	1,579
Iron and steel:		
Ore and concentrate ---thousand tons--	1,025	787
Metal:		
Scrap	23,780	98,167
Pig iron, including cast iron	22,313	15,431
Sponge iron, powder, shot	667	515
Ferroalloys	12,932	5,786
Steel, primary forms	494,026	277,273
Semimanufactures:		
Bars, rods, angles, shapes, sections	208,058	155,649
Universals, plates, sheets	197,199	159,617
Hoop and strip	41,933	42,689
Rails and accessories	17,725	8,257
Wire	14,213	10,040
Tubes, pipes, fittings	28,154	16,547
Castings and forgings, rough	2,139	1,878
Lead:		
Ore and concentrate	4,848	7,614
Metal including alloys, unwrought and semimanufactures	15,463	8,554
Magnesium metal including alloys, unwrought	280	NA
Manganese ore and concentrate	22,709	2,437
Nickel metal including alloys:		
Unwrought	38	39
Semimanufactures	308	378
Platinum-group and silver metals including alloys:		
Platinum-group ---value, thousands--	r $415	$171
Silver ---thousand troy ounces--	2,186	(1)
Tin metal including alloys, unwrought and semimanufactures	506	595
Titanium oxides	4,649	NA
Tungsten metal including alloys, all forms	1	NA
Zinc:		
Oxide	537	NA
Metal including alloys:		
Unwrought	11,363	11,695
Semimanufactures	140	116
Other:		
Ores and concentrates, n.e.s	r 2,551	1,256
Ash and residue containing nonferrous metals, n.e.s	r 642	1,125
Oxides, hydroxides, peroxides of metals, n.e.s	--	NA
Metals including alloys, all forms:		
Metalloids	288	NA
Alkali, alkaline earth, rare-earth metals	5,864	NA
Base metals including alloys, all forms, n.e.s	r 40	33
NONMETALS		
Abrasives, natural, n.e.s.:		
Dust and powder of precious and semiprecious stones---value, thousands--	r $1,793	NA
Grinding and polishing wheels and stones	466	587
Asbestos	19,371	13,315
Boron materials:		
Crude natural borates	--	NA
Oxide and acid	--	NA
Cement	701	938
Chalk	--	NA
Clays and clay products (including all refractory brick):		
Crude	104,457	NA
Products:		
Refractory (including nonclay bricks)	r 34,827	28,053
Nonrefractory	r 2,802	5,043
Diatomite and other infusorial earth	--	NA
Feldspar and fluorspar	7,183	NA

See footnotes at end of table.

Table 3.—Greece: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS—Continued		
Fertilizer materials:		
Crude:		
Phosphatic	330,376	454,638
Other	--	511
Manufactured:		
Nitrogenous	r 14,205	52,399
Potassic	r 11,036	28,140
Other, including mixed	r 2,301	671
Ammonia	36,188	NA
Graphite, natural	--	NA
Gypsum and plasters	--	NA
Magnesite	1,475	NA
Pigments, mineral, including processed iron oxides	1,818	NA
Precious and semiprecious stones, except diamond, natural ---kilograms	2,000	(2)
Pyrite, gross weight	118,868	154,015
Salt	r 51,087	NA
Sodium and potassium compounds, n.e.s.:		
Caustic soda	35,977	NA
Caustic potash, sodic and potassic peroxides	512	NA
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	1,535	NA
Worked	362	392
Dolomite, chiefly refractory grade	--	NA
Other calcareous stone, n.e.s	--	NA
Gravel and crushed rock, n.e.s	--	NA
Sand, excluding metal bearing	84,860	NA
Sulfur, elemental, other than colloidal	214,048	83,741
Talc, steatite, soapstone, pyrophyllite	2,092	NA
Other:		
Crude	--	NA
Oxides and hydroxides of magnesium, strontium, barium	--	NA
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	r 477	929
MINERAL FUELS AND RELATED MATERIALS		
Carbon black	3,202	NA
Coal and briquets:		
Anthracite and bituminous coal	840,688	708,908
Briquets of coal	r 2,624	22,190
Coke and semicoke	r 42,897	31,258
Hydrogen and rare gases	--	NA
Petroleum:		
Crude and partly refined ---thousand 42-gallon barrels	88,904	94,113
Refinery products:		
Gasoline (including natural) ---do	r 108	63
Kerosine and jet fuel ---do	r 1,310	972
Distillate fuel oil ---do	1,086	1,632
Residual fuel oil ---do	1,554	1,427
Lubricants ---do	r 564	488
Mineral jelly and wax ---do	r 5	10
Other:		
Liquefied petroleum gas ---do	r 328	361
Nonlubricating oils, n.e.s ---do	--	NA
Pitch and pitch coke ---do	404	
Bitumen and other residues ---do	285	
Unspecified ---do	r 9	
Total ---do	r 5,653	NA
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	10,982	8,106

r Revised. NA Not available.
1 Value reported at $11,815,000.
2 Value reported at $183,000.

COMMODITY REVIEW

METALS

Aluminum.—Plans for a new alumina plant and expansion of existing bauxite mines were the highlights of the aluminum industry of Greece during 1976. Although 2.7 million tons of bauxite was produced, output of alumina and aluminum for the past several years averaged only 470,000 tons and 135,000 tons, respectively. The new alumina plant should improve the situation and change Greece from a producer and exporter of bauxite to a processor of bauxite and exporter of alumina.

Greece's largest bauxite mining company, Bauxites Parnasse Mining Co., planned construction of a 600,000-ton-per-year alumina plant near Itea, on the Gulf of Corinth, with provisions to double its capacity. Chase Manhattan Bank was arranging a financial package and foreign participation for an initial investment of $200 million, with an additional $100 million for expansion. Bauxites Parnasse will control 51% of the equity of the corporation to be created to carry out the project. The Government approved a plan for expansion of mines in the Parnassós-Ghiona area from 2 million tons to 3.2 million tons. The operator, Bauxites Parnasse, plans to invest $10 million in this expansion.

Eleusis Bauxite Mines, part of Mining-Industrial & Shipping Inc., established centers for production of bauxite at Oeta Mountain in central Greece, at Atalándi in Phthiotis, and on Amorgós Island. Deposits are small, and equipment and personnel move from deposit to deposit while maintenance and supplies remain in the three centers. A smaller bauxite producer, Barlos Bauxite Hellas S.A., purchased new equipment and planned to expand its present output of 200,000 tons per year at mines in Fokis and Boeotia by an additional 50,000 tons.

Aluminium de Grèce S.A. (AG) was the operator of the only aluminum smelter in Greece, situated at Distomon, Boeotia, and a nearby 500,000-ton-per-year alumina plant. During 1976, AG was installing a pollution-control system at its facility at a cost of $10 million. Bauxite exports, about 75% of the output, were again based on export quotas allocated by the Ministry of Commerce. The 1977 quota was set at 2.3 million tons, 28% below the 1976 quota, mostly because of lower demand in market economy countries.

Chromite.—The Government of Greece, through GEMEE, assigned priority to exploration and development of chromite deposits at Vourinos Mountain near Kozáni. Expenditures for new equipment for GEMEE's Skoumitsa mine in the Vourinos area, mostly for drills and wagons, totaled $1 million in 1976. During 1976, ores from the Vourinos deposits were upgraded in an obsolescent 15,000-ton-per-year beneficiation plant, but a feasibility study on a new 60,000-ton-per-year beneficiation installation was ordered and is to be completed by 1978.

Eleusis Bauxite started reactivating the idle Dhomokós chromite mine near Lamia. Eleusis Bauxite also produced chromite concentrates at a plant situated at Eretria near Vólos and explored for chromite near Kozáni.

Iron and Steel.—A ministeelplant was completed in the Almirós area near Vólos. Plant capacity, with two electric furnaces, was 260,000 tons per year, and the operator was Metallurgiki-Chalps. Normal output was expected to be achieved in the first half of 1977.

The domestic iron and steel industry, although modest by world standards, was an important factor in the country's economy. The only integrated steel producer in the country remained Halyvourghiki S.A. with a plant near Eleusis, which accounted for about 75% of the country's steel production. Shipbuilding remained the principal use of steel.

Lead, Zinc, Pyrites.—A new 360,000-ton-per-year underground complex sulfide ore mine and a corresponding beneficiation plant started production at Olimpias, Khalkidhikí. The owner, Hellenic Chemical Products & Fertilizer Co. Ltd., invested about $14 million in the project. When full operation is attained, annual output should reach 21,000 tons of silver-bearing lead concentrate (65% lead, 1,600 grams of silver per ton), 30,000 tons of zinc concentrate (55% zinc), and 100,000 tons of pyrite concentrate (46% sulfur, 20 grams of gold per ton). The company was conducting economic studies for total utilization of these complex sulfide ores within Greece. Preliminary plans indicated con-

struction of a 550,000-ton-per-year sulfuric acid plant, a 60,000-ton-per-year lead smelter, a 50,000-ton-per-year zinc smelter, a plant for recovery of nonferrous metals from iron cinder based on Japanese Kowa-Seiko technology, and a small 15-ton-per-year copper cathode plant. An investment of about $190 million would be needed for the project. At the Laurium mines, operated by Compagnie Française des Mines du Laurium, economic conditions deteriorated during 1976, owing to low market prices and low ore grade.

Nickel.—During 1976, the Government of Greece approved LARCO's plan for a $50 million expansion of installed nickel-producing capacity near Larymna from the present 15,000 tons to 27,000 tons per year, to be completed by 1978. To meet the demand of the smelter, the Government also approved doubling the annual output of the nearby mine, which is presently 1.7 million tons of lateritic ore. LARCO planned to provide financing of $17 million from its own funds, while about $33 million would be borrowed abroad. LARCO was planning a subsequent $170 million investment to establish an additional 13,000-ton-per-year nickel plant nearby, bringing the company's annual capacity to 40,000 tons of nickel. However, implementation of this plan depended on world market conditions. During 1976, LARCO purchased equipment, mostly U.S.-made, for about $8.5 million.

Eleusis Bauxite completed construction of a pilotplant of French design for beneficiation of ores from Psakhná (central Euboea). The deposit was rated at 70 million tons of lateritic ore of about 1% nickel-cobalt content. Eleusis Bauxite was asking for approval of a $60 million to $65 million investment in a mine and a 10,000-ton-per-year nickel plant.

NONMETALS

Asbestos.—Cerro Corp., after terminating its partnership with ETVA in development of the Zidanion mines near Kozáni, sold all its rights to ETVA. The Government was searching for another foreign partner.

Barite.—A barite deposit was discovered on Mílos Island. Geologists for Silver and Baryte Ores Mining Co., one of the largest barite producers in Greece, estimated reserves at 3 million tons (30% to 50% barium sulfate content). At yearend, a feasibility study was underway to determine the economics of production to supply a 50,000-ton-per-year beneficiation plant.

Cement.—During 1976, Greece's annual cement-producing capacity reached 11.7 million tons. The increase in capacity of 2.5 million tons resulted from completion of General Cement Co. S.A.'s 1.5-million-ton-per-year plant at Vólos and Chalkis Cement Co. S.A.'s 1-million-ton-per-year cement plant at Mikro Vathy near Chalkis. The Government authorized investments totaling $300 million in six new cement plants, but no locations or capacities for the new plants were mentioned. Domestic cement consumption was up 11%, and exports rose 16% in volume.

Clays.—*Bentonite.*—Silver and Baryte Ores started construction on Mílos Island of a new bentonite plant to increase annual capacity from 260,000 tons to 350,000 tons. At a later stage, plans call for additional expansion to 500,000 tons of bentonite per year.

Fertilizer Materials.—*Phosphate Rock.*—IGME announced the discovery of a phosphate rock deposit at Delvinákion, near Ioánnina, with reserves of 10 million tons (15% P_2O_5 content). In addition, geologists for Hellenic Chemical Products & Fertilizer discovered important phosphate rock deposits on the Ionian Islands and in Epirus. However, details of the deposits were not made public.

Magnesite.—During 1976, magnesite was among the most active mineral commodities in Greece. However, export of magnesite refractories was adversely affected by the slow recovery of the steel industry in Europe.

A pilotplant for production of magnesia from seawater came onstream at Mantoudhi, Euboea. This plant was part of a large $50 million project financed by Financial Mining-Industrial & Shipping Corp. (FIMISCO) that would include a 100,000-ton-per-year plant for extracting refractory magnesia from seawater.

In early 1976, FIMISCO received Government approval for development of magnesite mines and construction of a 36,000-ton-per-year sink-float beneficiation plant of French origin on Lésvos Island, and exploratory drilling was underway at the mine site during the year. Total investment for the mine and plant was planned at $3.5 million. FIMISCO also started production

of briquetted deadburned magnesite from low-grade magnesite and tailings at a 50,000-ton-per-year plant, also at Mantoudhi. The plant includes a flotation section, two vertical kilns, and a briquetting press. Construction costs were reported at $10 million.

Another producer of magnesite, Macedonian Magnesite Ltd. (part of Mining-Industrial & Shipping Corp.) (Scalistiri Group), obtained approval for investment of $8.6 million in expansion of the Ormalia mine and construction of a magnetic dressing plant and a 50,000-ton-per-year plant for briquetting deadburned magnesite.

Grecian Magnesits Ltd. S.A., as part of a $10 million expansion plan, purchased new mining equipment for its open cast mines at Gerakini, Khalkidhikí, and completed a cyclone separation installation nearby.

A new magnesite beneficiation plant, operated by Magnomin General Mining Co., a subsidiary of General Refractories Co. (United States), started production in Khalkidhikí using a Belgian-Yugoslav method (basically sink-float) for upgrading low-grade magnesite and tailings.

At Troupi, northern Euboea, a new 87,000-ton-per-year magnesite concentrator and a 35,000-ton-per-year deadburned magnesite rotary kiln were completed. The owner, Magnesite Mining-Industrial and Commercial S.A., expected to have the plant in normal operation early in 1977.

Perlite.—Silver and Baryte Ores was planning construction of a 40,000-ton-per-year perlite treatment plant on Kos Island. At yearend, approval from the Greek Government, needed for actual beginning of construction, had not been granted.

The largest deposits of perlite in Greece are situated on Mílos and Kos Islands in the Aegean Sea. On Mílos, the largest deposits are in the area of Trachila and Chibadolimni. Total perlite reserves were estimated at 100 million tons. Silver and Baryte Ores, General Enterprise Sarides S.A., and Mykobar Mining Co. (a subsidiary of Dresser Industries, Inc., of the United States) were among the largest perlite producers.

Salt.—A salt deposit was discovered near Préveza in Epirus. IGME was continuing exploration to determine the size of the new deposit.

MINERAL FUELS

Imported petroleum remained the principal source of energy in Greece. During 1975, the latest year for which complete data are available, about 74% of Greece's apparent fuel and power consumption was met through net imports. Crude oil and refinery products accounted for approximately 97% of primary energy imports. Lignite was the principal form of energy produced in the country and provided 25% of apparent energy consumption. However, importing high-rank coals was necessary to meet demand. Table 4 shows the supply and apparent consumption of fuels and power for 1974 and 1975.

Table 4.—Greece: Supply and apparent consumption of fuels and power in 1974 and 1975

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products	Fuelwood	Hydro-electrical power
1974:					
Production	4.9	4.6	--	(2)	0.3
Imports	20.5	1.0	19.5	(2)	(2)
Exports	3.6	(2)	3.6	(2)	(2)
Apparent consumption	21.8	5.6	15.9	(2)	.3
1975:					
Production	6.2	5.9	--	(2)	.3
Imports	22.6	.6	22.0	(2)	(2)
Exports	4.8	(2)	4.8	(2)	(2)
Apparent consumption	24.0	6.5	17.2	(2)	.3

[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Less than ½ unit.

Source: United Nations. World Energy Supplies (1950–75), Statistical Papers, ser. J. No. 20, 1977, 239 pp.

Coal.—Lignite was the only mineral fuel produced in significant commercial quantities in Greece during 1976. High prices for imported energy made domestic low-grade lignites more attractive than in the past. Consequently, development of existing deposits and exploration for new ones continued. IGME conducted exploration, mostly in northwestern Greece, with funds supplied by Government-owned PPC, the major lignite mine operator in the country.

Of a total production of 22 million tons of lignite, 15 million tons was produced from the Ptolemaïs mines, 6.4 million tons at the Megalópolis lignite field, and 0.6 million tons at Alivérion, Euboea. Most of the lignite produced was used for production of electrical power. Lignite-fired powerplants accounted for about 55% of the total electrical energy produced in the country.

During 1976, PPC started implementing plans aimed at increasing output and consumption of lignite in Greece. According to plans for the Ptolemaïs lignite deposit (which has proven reserves of 1.4 billion tons with a calorific value of 1,400 kilocalories per kilogram), expansion of mines should lead to an output of 18 million tons in 1980 and 42 million tons by 1990. The South Field area was slated to yield most of the new output. The Otto Gold firm of West Germany was engaged to complete a study on development of the South Field to supply lignite for seven 300-megawatt generating units at Kardia, beginning sometime between 1980 and 1986. PPC signed contracts for delivery of three bucket-wheel excavators by Fried. Krupp Hüttenwerke AG and Siemens AG; other contracts were let to the East German firm Maschinen-Export and the Swiss firm Brown, Boveri & Cie AG for delivery of two bucket-wheel excavators and four stackers. Deliveries under both contracts were scheduled for 1980. The management of PPC was planning to purchase locally an 11-kilometer-long conveyor belt, mainly for transportation of the overburden at the new mine.

At Megalópolis, where proven reserves are 470 million tons with an average calorific value of 960 kilocalories per kilogram, plans call for an output of 14 million tons by 1990. The Kiparission Field, which will be developed at Megalópolis, should account for the increased production.

At the Alivérion, Euboea, deposit, production will continue until 1978 from a mine based on a small lignite deposit with proven reserves of 2 million to 3 million tons with a calorific value of 2,800 kilocalories per kilogram.

Exploration was underway at numerous sites, the most significant of which were northern Ptolemaïs (proven reserves of 54 million tons), Amyneteon (proven reserves of 140 million tons), and Édhessa (proven reserves of 20 million tons).

Petroleum and Natural Gas.—During 1976, Greece was not a producer of petroleum and natural gas, and all demand was met through imports. However, exploration was underway offshore and onshore. Two wells were drilled offshore in the area of Thásos Island. Results were discouraging because producing formations apparently pinched out; consequently, estimates of reserves in the Prinos Field were lowered to 25,000 barrels per day for 15 years instead of the 50,000 barrels per day previously reported. In the fall, Oceanic Exploration Co. of Denver, Col., sold its 68.75% equity in the offshore oil exploration and development concession near Thásos Island to Denison Mines Ltd. of Canada. At yearend, a new company, North Aegean Petroleum Corp. (EPE), was organized to act as operator for the new consortium.

New legislation related to petroleum and natural gas, Law 468/761, was passed by the Greek Parliament, vesting the right of exploration and production of petroleum and natural gas in the State. The State may, however, contract exploration activities to a contractor, provided that exploration does not last longer than 4 years; in seawater deeper than 200 meters, exploration time may be extended another 2 years; when oil or gas is discovered, the lease for production should not exceed 25 years; and the State has the right to ask for a joint venture with the contractor if oil or gas is discovered.

In addition, Law 367/76, which became effective in June 1976, provided for compulsory expropriation of land required for oil and gas activities, including pipelines and storage facilities.

The crude oil capacity of petroleum refineries in Greece was 20 million tons per year, distributed as follows, in million tons:

Motor Oil (Hellas) Corinth Refineries (Vardinoyannis family)	7
Petrola Hellas S.A. refinery (shipowner John Latsis)	5
Hellenic Aspropyrgos Refinery S.A	4.8
Esso Pappas refinery	3.2
Total	20

Refinery throughput in 1976 was 11.1 million tons, or 55.5% of installed capacity. The Government canceled, by negotiated agreement, a 1970 $200 million contract with the Niarchos Group and repurchased for $12.4 million Niarchos' share in Hellenic Aspropyrgos Refinery. This takeover was designed to increase Government control over the Greek petroleum sector.

Uranium.—Exploration for uranium continued in northern Greece in an area west of the Axios River. Greek and foreign scientists working for the Atomic Energy Institute of Greece and United Nations teams were active in the Kaválla-Dráma area.

The possibility of building a nuclear powerplant was considered by authorities in Greece. However, no decision was made public at yearend.

The Mineral Industry of Hungary

By Jozef Plachy [1]

The year 1976 was the beginning of the fifth 5-year plan. Reportedly, the overall 4.1% increase in industrial production during 1976 was led by the chemical industry (up 11.1%), followed by the electric energy industry (up 7.8%). The increase in output of machinery, an important export item, dropped to 4.2% in 1976 from 4.8% in 1975.

In compliance with new economic regulations, priorities were assigned to investment projects crucial to the national economy. The pertinent accelerated investments completed in 1976 were the second and third stages of the Danube Thermal Powerplant at Százhalombatta, the second stage of the Danube Petroleum Enterprise, phase 2 of the Székesfehérvár Light Metal Works wide strip rolling mill, phase 1 of the press works of the Ózd Metallurgical Works continuous steel casting and bar/wire-rolling mill, the Hejöcsaba Cement Plant, and the Pét Nitrogen Plant.

The fifth 5-year plan allocates 870 billion forints (Ft) for investments, 40% of which is earmarked for industry. In 1976, industrial investment amounted to Ft58.4 billion, or 38.9% of total 1976 investment. The allocation of investment funds, production, and employment within the various industrial branches for 1976 is shown in the following tabulation:

Industry	Investment			Gross industrial production		Employment	
	According to fifth 5-year plan (percent)	Actual		Billion forints	Percent	As of January 1	Percent change from 1975
		Million forints	Percent				
Electric energy	19.7	8,176	14.0	24.0	3.5	38,600	+0.4
Chemical	14.7	11,563	19.8	105.7	15.4	118,600	—.2
Engineering	14.1	10,220	17.5	180.6	26.3	552,300	—.4
Mineral	13.0	5,782	9.9	30.9	4.5	122,000	—1.2
Food processing	9.9	7,475	12.8	131.2	19.1	197,900	--
Light	8.8	6,716	11.5	116.0	16.9	452,500	—1.4
Building materials	8.5	4,088	7.0	22.0	3.2	81,000	—2.4
Metallurgy	7.9	3,738	6.4	65.2	9.5	102,400	—1.0
Other	3.4	642	1.1	11.0	1.6	62,700	—.4
Total	100.0	58,400	100.0	686.6	100.0	1,728,000	—.8

Source: Statistical Pocket Book of Hungary, Budapest. 1977.

About 70 mineral commodities are produced in Hungary. The economically significant mineral reserves total more than 7 billion tons, representing approximately 15% of national resources.[2] More than half of the minerals suitable for industrial use are for construction use; 30% are solid fuel resources; 8% are various other nonmetallic minerals; approximately 4% are metal-bearing ores such as bauxite, copper ore, lead ore, zinc ore, iron ore, and manganese ore; and 2% are liquid hydrocarbons. Although the mineral fuels and metallic ores amount to only 36% of total mineral reserves, their value is almost 90% of all natural resources.[3]

[1] Physical scientist, International Data and Analysis.

[2] Hazai Tudósítások (Domestic Information), Budapest. V. 13, No. 19, Sept. 1, 1976, pp. 5–6.

[3] Work cited in footnote 2.

In 1976, 58% of total energy needs, 95% of mineral raw material needs, and almost 100% of construction industry mineral raw material needs were supplied by indigenous production.[4] Mining is basically conducted by three organizations: Magyar Szénbányászati Tröszt (Hungarian Coal Mining Trust) (MSZT), Országos Köolaj-és Gázipari Tröszt (National Petroleum and Gas Trust) (OKGT), and Országos Érc-és Ásványbányászati Vállallat (National Ore and Mineral Mining Enterprise) (OEAV).

The largest of the three enterprises is the MSZT with a total employment of 82,000 people, 87% of which are miners.[5] The OKGT manages 27 firms and employs 51,000 people.[6] The OEAV operates 22 surface mines, 10 underground mines, and 25 processing plants, and some 86% of its mined minerals are processed.[7] The OEAV is divided horizontally into seven independent organizations: The Transdanubia (Dunántúl), Hegyalja, and Mátra regions; the Recsk, Úrkút, and Rudabánya mines; and the Prospecting and Exploring Enterprise. In addition, it is organized vertically to insure better coordination of operations occurring during mining, processing, and marketing of minerals and/or semifinished products.

PRODUCTION

In the light of Hungary's increasing dependence on imports of primary materials, mining remains the most crucial branch of industry. A 12.1% increase in oil and natural gas production was generated mainly by stepped-up production at the Szeged-Algyö Fields. Petroleum output from this area increased over 20% and constituted three-fourths of total production. Natural gas production in the same region was approximately 60% of the total production in Hungary. In 1976, expansion of the Danube Thermal Powerplant was completed, resulting in a 7.6% increase in electric energy production.

Except for fossil fuel production, bauxite mining is the most significant branch of Hungary's mineral industry. With the opening of the Iza II mine, bauxite production recorded a 1% increase. The 3.6% increase in gross production by the entire metallurgy sector in 1976 proved inadequate to offset the small decline of the previous year.

[4] Work cited in footnote 2.
[5] Figyelö (Observer), Budapest. May 18, 1977, p. 16.
[6] Világgazdaság (World Economy), Budapest. Feb. 23, 1977, pp. 5–8.
[7] Népszabadság (People's Freedom), Budapest. Jan. 21, 1977, p. 1.

Table 1.—Hungary: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum:			
Bauxite	2,751	2,889	2,918
Alumina	691	756	732
Metal, primary	69,043	70,221	70,499
Copper:			
Mine output, metal content [e]	1,200	1,000	1,360
Metal:			
Smelter, primary [e]	1,200	1,000	1,100
Refined, including secondary	[e] 14,000	13,010	12,049
Gold, mine output, troy ounces	[e] 320	161	--
Iron and steel:			
Iron ore	545	642	602
Pig iron:			
For steel	2,217	2,142	2,111
For foundries	73	77	110
Total	2,290	2,219	2,221
Ferroalloys	8	7	7
Crude steel	3,468	3,673	3,652
Steel semimanufactures, rolled only	2,392	2,675	2,857
Lead:			
Mine output, metal content	[e] 1,600	716	864
Metal, refined, secondary	13,500	[e] 13,000	12,500
Manganese concentrate [2]	114	131	125
Silver, thousand troy ounces	[e] 64	67	71
Zinc:			
Mine output, metal content	[r] 3,000	2,200	[e] 2,200
Smelter, secondary	701	680	655

See footnotes at end of table.

Table 1.—Hungary: Production of mineral commodities—Continued

(Thousand metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
NONMETALS				
Cement, hydraulic		3,437	3,759	4,298
Clays:				
Bentonite		77	88	71
Kaolin, crude and washed		79	89	72
Fertilizer materials, manufactured:				
Nitrogenous:				
Gross weight		1,918	2,056	2,402
Nitrogen content		393	421	492
Phosphatic:				
Gross weight		1,021	1,090	994
P_2O_5 content		190	206	188
Ammonia, anhydrous		602	624	855
Lime, calcined		636	714	733
Peat (agricultural use) [e]		65	65	70
Perlite		93	72	96
Pyrite, gross weight [e]	tons	7,000	7,000	7,000
Refractory materials, n.e.s.:				
Chamotte products		175	171	169
Chrome magnesite products		47	42	47
Sand and gravel:				
Gravel	thousand cubic meters	11,602	11,860	12,625
Sand, common	do.	417	437	471
Sand, molding		467	710	687
Stone:				
Dimension, all types		5	4	4
Other:				
Dolomite		960	1,089	1,126
Limestone		7,067	7,510	8,038
Quartzite		29	33	42
Sulfur:				
From pyrite [e]	tons	2,800	2,800	2,800
Byproduct, all sources	do.	9,391	8,937	7,778
Total	do.	12,191	11,737	10,578
Sulfuric acid		657	630	617
Talc [e]		16	16	16
MINERAL FUELS AND RELATED MATERIALS				
Carbon black [e]	tons	[r] 4,200	4,500	4,000
Coal:				
Bituminous		3,209	3,020	2,934
Brown		15,281	14,963	14,779
Lignite		7,271	6,904	7,544
Total		25,761	24,887	25,257
Coke:				
Coke oven coke		639	593	604
Gas coke		401	407	372
Total		1,040	1,000	976
Fuel briquets		1,114	1,082	1,018
Gas:				
Manufactured	million cubic feet	23,519	22,495	22,528
Natural, marketed	do.	180,139	183,000	214,760
Natural gas liquids:				
Natural gasoline	thousand 42-gallon barrels	672	757	1,147
Liquefied petroleum gas	do.	1,032	1,299	3,387
Petroleum:				
Crude:				
As reported		1,997	2,006	2,142
Converted	thousand 42-gallon barrels	15,237	15,306	16,343
Refinery products: [3]				
Gasoline, including naphtha	do.	11,424	16,142	18,403
Kerosine	do.	8	8	3
Distillate fuel oil	do.	23,932	25,938	26,177
Residual fuel oil	do.	20,067	22,870	22,378
Lubricants	do.	[r] 1,463	1,321	1,463
Other:				
Liquefied petroleum gas	do.	[r] 986	1,032	1,194
Asphalt and bitumen	do.	3,563	3,691	3,612
Paraffin and petrolatum	do.	196	170	200
Total	do.	[r] 61,639	71,172	73,430

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the commodities listed, diatomite, gypsum, and other crude construction materials such as common clay are produced but available information is inadequate to make reliable estimates of output levels.

[2] Contains 30% to 33% manganese.

[3] Excludes refinery fuel and losses.

TRADE

The value of Hungarian foreign trade in 1976 reached Ft434,890 million of which Ft204,834 million represented exports and Ft230,056 million imports.[8] Because of the new exchange rate incorporated in the new economic regulations and introduced on January 1, 1976, a comparison with the previous year would be inaccurate. The commercial exchange rate is now Ft-40–41=US$1.00, and the tourist rates are Ft20.63=US$1.00 and Ft20.67=US$1.00 (selling and buying, respectively).

Hungary's major trading partners in 1976 are as follows:[9]

Country	Exports		Imports	
	Million forints	Percent	Million forints	Percent
U.S.S.R	61,783	30.2	61,192	26.6
Germany, East	18,138	8.9	20,034	8.7
Czechoslovak'a	15,235	7.4	14,561	6.3
Germany, West	16,814	8.2	22,522	9.8
Austria	8,183	4.0	12,608	5.5
Italy	9,795	4.8	10,707	4.7

The value of Hungarian trade with the United States in 1976 was Ft5,976 million ($146 million) of which 35.6% was exports and 64.4% was imports, showing an Ft1,720 million ($42 million) trade deficit.[10]

With the exception of bauxite and, to a certain extent, manganese ore, Hungary is a net importer of energy, raw materials, and semifinished products. While the trade balance in machinery, transportation equipment, and investment goods was favorable with centrally planned economy countries, it showed a small deficit with market economy countries.

During 1977, foreign trade is to increase 10.9% to Ft482,482 million, of which 48.7% is to represent exports and 51.3% imports. Planned increases are 12% and 7% for exports and imports, respectively, for centrally planned economy countries and 17% to 18% and 8%, respectively, for market economy countries.[11]

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[8] Külkereskedelmi Statisztikai Évkönyv (Statistical Yearbook of Foreign Trade), Budapest. 1976.
[9] Work cited in footnote 8.
[10] Work cited in footnote 8.
[11] Népszabadság (People's Freedom), Budapest. Dec. 19, 1976, p. 3.

Table 2.—Hungary: Exports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum: [2]			
Bauxite ---thousand tons--	r 559	603	Czechoslovakia 313; East Germany 180; Poland 110.
Alumina:			
Hydrate	7,255	9,461	Finland 6,518; Yugoslavia 2,931.
Calcined	626,292	686,065	U.S.S.R. 403,436; Poland 135,957; Austria 88,660.
Metal including alloys:			
Scrap	19,784	17,626	Austria 8,153; Italy 6,971; West Germany 2,409.
Unwrought	54,727	60,821	Poland 9,850; People's Republic of China 9,434; West Germany 5,547.
Semimanufactures	30,725	48,613	Romania 20,294; East Germany 7,595.
Chromium oxide and hydroxide	150	107	Yugoslavia 70; Italy 37.
Copper:			
Ore and concentrate	448	--	
Metal including alloys:			
Scrap	1,556	1,273	West Germany 929; Austria 344.
Unwrought and semimanufactures	r 11,699	6,879	West Germany 4,483; United Kingdom 1,073; Austria 592.
Iron and steel:			
Scrap ---thousand tons--	102	22	Italy 11; West Germany 9; Yugoslavia 2.
Pig iron and ferroalloys [2] ---do---	281	99	Italy 23; Poland 21; Austria 17.
Steel, primary forms [2] ---do---	175	79	Yugoslavia 25; Austria 10; Romania 10.
Semimanufactures [2] ---do---	607	873	U.S.S.R. 107; Poland 94.
Castings and forgings, rough [2] ---do---	18	13	Poland 3; Bulgaria 2; Czechoslovakia 2.
Lead:			
Ore and concentrate	2,445	1,556	All to Belgium-Luxembourg.
Oxides	550	--	
Metal including alloys, all forms	461	--	
Manganese ore and concentrate [2]	15,173	25,816	West Germany 18,075; Czechoslovakia 7,741.
Nickel metal including alloys, all forms	485	881	Sweden 346; Netherlands 341; West Germany 132.
Platinum-group metals and silver:			
Waste and sweepings --value, thousands--	$2,456	$2,119	All to West Germany.
Metals including alloys:			
Platinum-group ---do---	$248	$76	All to Italy.
Silver ---do---	$36	$483	All to West Germany.
Tin metal including alloys	60	20	All to Austria.
Zinc:			
Oxide	122	--	
Metal including alloys:			
Scrap	328	128	All to West Germany.
Unwrought and semimanufactures --value, thousands--	$48	--	
Other:			
Ores and concentrates [2]	6,825	6,324	Poland 4,494; Belgium-Luxembourg 1,692.
Ash and residues containing unspecified nonferrous metals	11,779	13,562	Austria 8,192; West Germany 4,542.
Base metals including alloys, all forms, n.e.s ---value, thousands--	$612	$91	All to Netherlands.
NONMETALS			
Asbestos	2,282	2,182	West Germany 1,261; Belgium-Luxembourg 921.
Cement, hydraulic [2] ---thousand tons--	33	65	Yugoslavia 25; Czechoslovakia 20; Bulgaria 11.
Clays and clay products:			
Crude: [2]			
Bentonite	23,080	23,128	East Germany 16,876; Poland 3,621.
Fire clay	986	293	All to Bulgaria.
Kaolin	8,350	7,806	Czechoslovakia 6,695; West Germany 936.

See footnotes at end of table.

Table 2.—Hungary: Exports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Clays and clay products—Continued			
Products:			
Refractory (including nonclay bricks) [2]	31,112	31,317	West Germany 7,996; Romania 6,139; Italy 4,580.
Nonrefractory	r 69,215	4,142	All to Yugoslavia.
Cryolite and chiolite	485	397	All to United States.
Diamond:			
Gem—value, thousands	$745	$328	All to Belgium-Luxembourg.
Industrial—do	$74	$185	Do.
Diatomite and other infusorial earth	3,382	2,458	All to Austria.
Fertilizer materials:			
Manufactured, unspecified	41,768	41,217	West Germany 33,904; Yugoslavia 5,528.
Ammonia [2]	31,123	37,601	Yugoslavia 34,414.
Magnesite [2]	8,990	8,775	Italy 2,572; West Germany 2,002; Sweden 1,501.
Pigments, mineral: Iron oxides, processed	245	--	
Stone, sand and gravel:			
Dimension stone	r 714	--	
Gravel and crushed rock	97,663	137,968	All to Yugoslavia.
Limestone and dolomite	27,515	50,220	Yugoslavia 40,167; Poland 10,053.
Sand, excluding metal bearing [2]	53,396	27,765	Yugoslavia 16,664; Austria 11,101.
Sulfur:			
Elemental	1,201	--	
Sulfuric acid, oleum [2]	102,768	40,809	Yugoslavia 36,058.
Other:			
Crude	39,803	40,095	Austria 15,691; West Germany 13,734; Yugoslavia 9,291.
Slag, dross, and similar waste, not metal bearing	32,526	24,183	Yugoslavia 21,454; Italy 2,729.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural	NA	1,190	All to Yugoslavia.
Coal and briquets: [2]			
Anthracite and bituminous—thousand tons	6	--	
Briquets—do	63	30	Yugoslavia 29.
Lignite—do	68	96	Austria 40; Yugoslavia 30; U.S.S.R. 26.
Coke from bituminous coal [2]—do	43	7	Yugoslavia 6; Italy 1.
Gas, natural [2]—million cubic feet	228	157	All to U.S.S.R.
Peat and peat briquets [2]	2,922	1,538	Yugoslavia 1,112; Austria 426.
Petroleum:			
Crude and partly refined [2]—thousand 42-gallon barrels	(3)	--	
Refinery products:			
Gasoline—do	r 1,751	1,326	NA.
Kerosine [2]—do	r 123	197	U.S.S.R. 117; Poland 17.
Distillate fuel oil [2]—do	85	214	U.S.S.R. 110; West Germany 95.
Residual fuel oil [2]—do	687	1,119	Austria 1,104.
Lubricants—do	396	303	Austria 211; Poland 57.
Other:			
Nonlubricating oils, n.e.s.—do	327	33	West Germany 18; Yugoslavia 12.
Liquefied petroleum gas [2]—do	117	194	Austria 92; West Germany 45; Italy 26.
Mineral jelly and wax [2]—do	153	127	Italy 76.
Bitumen [2]—do	396	364	Poland 127; West Germany 91; Austria 76.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	874	1,995	Yugoslavia 998; Italy 997.

r Revised. NA Not available.

[1] Unless otherwise specified, data are partially or wholly compiled from the 1975 edition of the United Nations World Trade Annual and the 1974 edition of the United Nations Supplement to the World Trade Annual, as well as official trade statistics of selected trading partner countries (Bulgaria, Czechoslovakia, East Germany, Poland, Romania, and the U.S.S.R.).

[2] Includes Official Hungarian Trade Statistics.

[3] Revised to none.

Table 3.—Hungary: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Oxide and hydroxide	r 16	--	
Metal including alloys, all forms [2]	r 139,399	146,860	U.S.S.R. 116,625; Poland 19,612.
Chromite	18,000	17,000	All from U.S.S.R.
Cobalt oxides and hydroxides	--	21	All from France.
Copper: [2]			
Copper sulfate	6,113	4,377	All from U.S.S.R.
Metal including alloys, all forms	r 42,633	44,528	U.S.S.R. 33,121.
Iron and steel: [2]			
Ore and concentrate ----thousand tons	4,105	4,261	U.S.S.R. 4,049.
Metal:			
Pig iron, ferroalloys, similar materials ----do----	321	315	U.S.S.R. 278.
Steel, primary forms ----do----	94	19	Yugoslavia 15.
Semimanufactures ----do----	r 1,019	1,095	U.S.S.R. 701; Poland 98.
Lead:			
Oxides	887	7,153	Austria 6,428.
Metal including alloys, all forms [2]	r 12,051	12,392	U.S.S.R. 10,721.
Magnesium metal including alloys, all forms	501	402	All from U.S.S.R.
Manganese ore [2]	14,614	14,914	Do.
Mercury ----76-pound flasks	406	--	
Molybdenum metal including alloys, all forms	66	28	Austria 20.
Nickel metal including alloys, all forms	69	[3] 206	West Germany 117; Switzerland 46; Sweden 21.
Platinum-group metals including alloys value, thousands	r $1,646	$2,087	West Germany $1,496; United Kingdom $478.
Silver metal including alloys ----do----	r $6,858	$1,292	West Germany $992; Switzerland $114.
Tantalum metal, all forms ----do----	$35	$53	All from Austria.
Tin:			
Oxide	12	8	All from West Germany.
Metal including alloys [2]	r 1,603	1,786	United Kingdom 397; Denmark 293.
Titanium oxides	4,913	[4] 2,466	Italy 1,644; West Germany 822.
Tungsten metal, all forms	4	1	All from Austria.
Zinc:			
Oxide	492	307	Belgium-Luxembourg 201; United Kingdom 106.
Metal, all forms [2]	r 24,516	26,513	U.S.S.R. 6,500; Belgium-Luxembourg 4,092; Italy 2,692.
Other:			
Ores and concentrates, n.e.s. [2]	29,611	19,714	U.S.S.R. 18,244.
Metals including alloys:			
Metalloids, n.e.s	856	663	Norway 660.
Base metals, n.e.s	106	[5] 58	United Kingdom 28; Italy 25.
NONMETALS			
Abrasives, natural [2]	5,060	r 5,241	West Germany 2,873; Italy 879; U.S.S.R. 857.
Asbestos, crude [2]	r 31,731	32,604	U.S.S.R. 27,705; Australia 4,400.
Barite and witherite	19,191	23,769	Yugoslavia 12,203; Ireland 10,870.
Bromine [2]	826	803	Israel 717; U.S.S.R. 86.
Cement, hydraulic [2] ----thousand tons	974	981	U.S.S.R. 754; East Germany 132.
Clays and clay products:			
Crude: [2]			
Fire clay	70,720	92,568	Czechoslovakia 68,101; Poland 8,486.
Kaolin	24,423	28,533	Czechoslovakia 11,845; Bulgaria 8,667; East Germany 7,370.
Other	67,432	79,988	Czechoslovakia 45,402; Italy 25,258.
Products:			
Refractory [2]	r 39,753	54,966	Austria 31,466; West Germany 7,847; East Germany 4,986.
Nonrefractory	2,615	1,691	West Germany 948; Sweden 743.
Diamond, gem and industrial value, thousands	$1,088	$1,197	Belgium-Luxembourg $933; Switzerland $264.
Diatomite and other infusorial earth	1,739	--	
Feldspar and fluorspar [6]	10,779	13,693	Yugoslavia 5,065; Finland 3,613; Norway 2,996.

See footnotes at end of table.

Table 3.—Hungary: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Fertilizer materials: [2]			
Crude:			
Phosphatic ---thousand tons--	603	702	U.S.S.R. 618; Algeria 52.
Potassic ---do---	3	3	East Germany 1; U.S.S.R. 1.
Manufactured:			
Nitrogenous ---do---	415	411	U.S.S.R. 186; Czechoslovakia 125; Austria 54.
Phosphatic ---do---	978	678	United States 202; U.S.S.R. 142; Yugoslavia 131.
Potassic ---do---	991	1,373	U.S.S.R. 837; East Germany 465.
Mixed ---do---	329	178	Austria 63; West Germany 57; Yugoslavia 53.
Fluorspar and cryolite	928	1,040	All from U.S.S.R.
Graphite, natural	402	199	All from West Germany.
Gypsum, calcined [2]	52,741	60,418	Romania 27,960; East Germany 23,284; Poland 9,131.
Iodine [2]	57	51	U.S.S.R. 26; Chile 15; Japan 9.
Lime [2]	60,073	31,074	Romania 14,647; Austria 10,160; Czechoslovakia 6,267.
Magnesite, calcined [2]	99,868	103,826	Czechoslovakia 77,887; U.S.S.R. 11,442.
Mica, crude and worked	62	66	Switzerland 44; United States 12.
Pigments, mineral: Iron oxides and hydroxides	2,572	2,564	West Germany 2,014; France 550.
Precious and semiprecious stones, except diamond ---value, thousands--	$76	--	
Pyrite, gross weight [2] ---thousand tons--	r 79	88	U.S.S.R. 82.
Salt ---do---	82	91	All from U.S.S.R.
Sodium and potassium compounds: [2]			
Caustic soda	118,998	139,307	Romania 74,543; West Germany 32,416.
Soda ash	r 161,796	159,708	Bulgaria 85,819; Romania 37,215; East Germany 25,035.
Caustic potash	r 999	1,254	East Germany 1,215.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked [2]	r 47,175	230,488	Romania 154,135; Czechoslovakia 66,151.
Worked	r 200	362	All from Italy.
Gravel and crushed rock [2]	r 29,423	41,919	Czechoslovakia 8,216; Bulgaria 6,914; Yugoslavia 4,501.
Quartz and quartzite	1,313	1,298	West Germany 1,116.
Sand, industrial [2]	81,630	97,281	Czechoslovakia 69,606; East Germany 18,948.
Sulfur: [2]			
Elemental	r 160,747	208,567	Poland 129,941; U.S.S.R. 78,488.
Sulfuric acid	19,272	23,645	Poland 23,389.
Talc and natural steatite	2,924	947	All from Austria.
Other:			
Crude, other than meerschaum	1,361	1,152	West Germany 1,021.
Oxides and hydroxides of magnesium, strontium, barium	236	327	West Germany 170; France 157.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black [2]	13,818	14,481	U.S.S.R. 10,587; Romania 2,913.
Coal and briquets: [2]			
Anthracite and bituminous ---thousand tons--	1,430	1,438	Czechoslovakia 569; Poland 483; U.S.S.R. 385.
Briquets ---do---	r 518	554	All from East Germany.
Coke, all types [2] ---do---	r 1,200	1,335	U.S.S.R. 739; Poland 302; Czechoslovakia 273.
Gas, natural [2] ---million cubic feet--	r 7,063	28,455	U.S.S.R. 21,213; Romania 7,063.
Hydrogen, helium, rare gases	2	2	All from West Germany.
Petroleum:			
Crude [2] ---thousand 42-gallon barrels--	r 50,105	62,153	U.S.S.R. 51,134; Iraq 8,981; Algeria 1,555.
Refinery products:			
Gasoline ---do---	1,123	1,288	U.S.S.R. 1,034; East Germany 150.
Kerosine ---do---	974	1,494	U.S.S.R. 1,302; East Germany 64.
Distillate fuel oil ---do---	4,561	2,431	U.S.S.R. 1,965; East Germany 263.

See footnotes at end of table.

Table 3.—Hungary: Imports of mineral commodities [1]—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum—Continued			
Refinery products—Continued			
Residual fuel oil thousand 42-gallon barrels	880	867	U.S.S.R. 814; Egypt 53.
Lubricants including grease ..do	170	238	U.S.S.R. 143; Romania 48.
Other:			
Nonlubricating oils, n.e.s ..do	15	11	Netherlands 6; Austria 4.
Liquefied petroleum gas [2] ..do	478	331	U.S.S.R. 243; East Germany 88.
Mineral jelly and wax ..do	1	1	All from West Germany.
Petroleum coke ..do	4	6	All from Italy.
Bitumen [2] ..do	343	410	Mainly from Albania.
Bituminous mixtures n.e.s ..do	r 1	(7)	All from Austria.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r 8,760	6,210	U.S.S.R. 3,726; West Germany 1,549.

r Revised.
[1] Unless otherwise specified, data are partially or wholly compiled from the 1975 edition of the United Nations World Trade Annual and the 1974 edition of the United Nations Supplement to the World Trade Annual, as well as official trade statistics of selected trading partner countries (Bulgaria, Czechoslovakia, East Germany, Poland, Romania, and the U.S.S.R.).
[2] Includes Official Hungarian Trade Statistics.
[3] Excludes quantity valued at $63,000.
[4] Excludes quantity valued at $376,000 from Finland.
[5] Excludes quantity valued at $255,000 from Belgium-Luxembourg.
[6] Totals exclude fluorspar reported elsewhere on this table as originating from the U.S.S.R.
[7] Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—The aluminum industry is one of the most important industries in Hungary. It employs over 40,000 people, and its share of the total value of national industry was almost 4%. With an export value of $90 million to market economy countries and 80 million rubles to centrally planned economy countries, it constituted nearly 5% of the total value of Hungarian exports.[12]

The Hungarian aluminum industry is under the management of Magyar Aluminiumipari Trószt (Hungarian Aluminum Trust) (MAT). The 1976 production and trade and planned goals for 1977 and 1980 are shown in the following tabulation, in tons:[13]

[12] Magyar Aluminium (Hungarian Aluminum), Budapest. V. 13, No. 9, 1977, p. 281.
[13] Statisztikai Havi Közlemény (Monthly Statistical Publication), Budapest. 1977.
Work cited in footnote 8.
Magyar Aluminium (Hungarian Aluminum), Budapest. V. 14, No. 1, 1977, pp. 1–5.

	Actual		Planned	
	1976	Percent change from 1975	1977	1980
Bauxite:				
Production	2,918,000	+1.0	2,920,000	3,050,000
Exports	633,000	+5.0	NA	NA
Alumina:				
Production	732,000	−3.2	785,000	800,000
Exports	621,000	−9.5	NA	485,000
Aluminum ingot:				
Production	70,499	+.4	71,000	72,000
Exports	53,927	−11.3	NA	NA
Imports	155,514	+5.9	NA	[1] 182,500
Semifinished products:				
Production	134,000	+.4	145,000	166,000
Exports	46,775	+.3	NA	NA
Imports	7,526	−24.1	NA	NA
Castings: [2]				
Production	19,000	--	NA	31,000
Exports	1,062	−46.5	NA	NA
Aluminum sulfate: Production	45,100	+23.0	48,100	NA

NA Not available.
[1] Long-term trade agreements already signed.
[2] Included with semifinished products as "Semimanufactures" on table 2.

In 1976, Hungary exported 328,680 tons of bauxite to Czechoslovakia and 190,023 tons to East Germany.[14] In 1962, Hungary signed a long-term alumina-aluminum agreement with the U.S.S.R., followed by a similar agreement with Poland. Under this agreement, 330,000 tons of alumina was shipped to the U.S.S.R. in 1976. In exchange, Hungary received 165,000 tons of aluminum. For the 80,000 tons of alumina shipped to Poland, Hungary received 17,500 tons of aluminum.[15] In a similar fashion, Hungary shipped 18,432 tons of alumina to Romania and imported 12,304 tons of aluminum and 5,056 tons of aluminum products. With imports of 20,624 tons of aluminum products in 1976, Sweden was the largest importer of Hungarian aluminum.[16]

Bauxite reserves are estimated at 110 million tons of 50% to 60% Al_2O_3.[17] The better quality is found at depths of 150 to 300 meters or more; only low-quality bauxite is found close to the surface. Consequently, less than 15% of bauxite is surface mined. The SiO_2 content averages between 7% and 8%.[18]

Bauxite reserves are located west and north of Lake Balaton, covering an area of less than 2,000 square kilometers. The northern part, between Székesfehérvár and Tatabánya, is known as the Fejer County Bauxite Mines. It supplies around one-third of the total national production. The Bakony bauxite mining region, stretching from Tapolca to Kislöd, is divided into two independent enterprises, the Halimba mines and the Nyirád-Darvastó mines. Both enterprises contribute almost equally to the remaining two-thirds of national production.

The only underground bauxite mine put into operation in 1976 was Iza (Iza-major) II. With the participation of 16 companies and an investment of Ft800 million, the Iza II mine reached its full capacity of 425,000 tons of bauxite in 1976 instead of 1980 as originally planned.

Future plans for the Bakony region include the opening of the Deáki bauxite mine in 1980 at a cost of Ft700 million, replacing the existing Deáki I and II mines soon thereafter. Under the lignite deposits at Nagyegyháza, 10 million tons of bauxite reserves have been found.[19] Work on a lignite-bauxite mine will start in January 1977, and by 1985 it should produce 500,000 tons of bauxite, later to be increased to 750,000 tons. In Fejer County, the Bitó II bauxite mine is to be opened in 1981, reaching its full annual capacity of 400,000 tons by 1983.

Individual mines and their production in 1976 are shown in the following tabulation:

[14] Work cited in footnote 8.
[15] Világgazdaság (World Economy), Budapest. Mar. 29, 1977, p. 3.
[16] Work cited in footnote 8.
[17] Kohászat (Metallurgy), Budapest. V. 109, No. 5, 1976, p. 222.
[18] Magyar Tudomány (Hungarian Science), Budapest. No. 2, 1973, pp. 96–99.
[19] Népszabadság (People's Freedom), Budapest. Dec. 24, 1976, p. 5.

Region	Independent enterprise	Production		Individual mines			Remarks
		Quantity [1] (thousand metric tons)	Average quality [2]	Name	Startup date	Capacity (thousand metric tons per year)	
Bakony	Halimba	1,000	6.8 modul, 51% Al_2O_3, 7.5% SiO_2.	Kislöd	1960's	100	Underground mines. The 20 million to 22 million tons of reserves are expected to last until 1985.
				Halimba II	1952	200	
				Halimba III	1973	600	
				Open pit mines	NA	100	Numerous small open pits.
	Nyirád-Darvastó	900	9.5 modul	Deáki I	1974	200	Both mines will cease production by the early 1980's, when replaced by a new one.
				Deáki II	1974	100	
				Iza II	1976	400	Ft800 million investment. Underground mine.
				Open pit mines	NA	200	Numerous small open pits.
Fejer County	Fejér	1,060	7.2 modul, 52.1% Al_2O_3, 7.3% SiO_2.	József III	1968	80	High-quality bauxite (9.1 modul, 53% Al_2O_3, 5.8% SiO_2).
				Iszkai II	1960's	400	Mine was renovated in 1972 and is expected to operate until 1982.
				Rákhegy II	1975	480	2 million tons of reserves at depths of 600 to 800 meters. Reserves are expected to last until 1987.
				Open pit mines	NA	100	Numerous small open pits.

NA Not available.
[1] Total quantity may differ from data given elsewhere because of independent rounding.
[2] Modul is calculated as the ratio of % Al_2O_3 to % SiO_2.

Nearly 80% of the bauxite production is processed domestically. Total alumina production by the end of the fifth 5-year plan should reach 440,000 tons. The largest and oldest alumina plant is located at Ajka, 120 kilometers southwest of Budapest, near Balaton. Future plans include an 80,000-ton capacity addition to the new alumina plant by 1980 and an increase in gallium recovery to 2.8 tons annually by 1977. The Ft350-million expansion project at the Almásfüzitö alumina plant, located on the Czechoslovak border 63 kilometers northwest of Budapest, was still under construction in 1976; according to plans, total annual capacity of the plant is to reach 320,000 tons of alumina by yearend 1977. In 1976, work began on a gallium extraction process based on Soviet technology. Gallium recovery at this plant is scheduled to begin by 1978 or 1979. The smallest of the three alumina plants in Hungary is located at Mosonmagyaróvár, 12 kilometers from the Austrian and Czechoslovak borders.

A number of alumina plants are being designed or built by the Hungarian aluminum planning organization, Aluminumipari Tervezo Vállalat (ALUTERV). Two alumina plants are being built in Yugoslavia. One, a 300,000-ton-per-year plant at Obrovac, was to start production in 1976. It was reported, however, that 85% to 90% of the work had been accomplished, at a cost of $150 million compared with a budgeted cost of $100 million.[20] A second alumina plant with a capacity of 600,000 tons per year is being built near Vlasenica in cooperation with the U.S.S.R. In addition, Hungarian experts are involved in installing equipment and training personnel for an alumina plant in India and in conducting bauxite prospecting in India, Cuba, and many African countries.

The capacity of Hungarian alumina plants in 1976 is shown in the following tabulation, in thousand tons per year:

Name and location	Capacity	Remarks
Ajkai Timföldgyár (Ajka)	385	The addition of 240,000 tons to annual capacity was completed in 1975 at a cost of Ft2.3 million. 80,000 tons of annual capacity is to be added by 1980.
Almásfüzitöi Timföldgyár (Almásfüzitö)	304	Additional capacity of 16,000 tons will be added by 1977 at a cost of Ft350 million. Gallium recovery based on Soviet technology is scheduled to start in 1978 or 1979.
Mosonmagyaróvári Timföld és mükorundgyár (MOTIM) (Mosonmagyaróvár).	72	By the end of the fifth 5-year plan, production is to increase by 27,000 tons at a cost of Ft560 million.

The energy intensity of aluminum production (15,000 kilowatt-hours per ton of aluminum) was the reason for alumina-aluminum agreements with the U.S.S.R. and Poland. As a result, the indigenous production of aluminum grew at a slower rate than other sectors of the aluminum industry.[21] However, recent discoveries of lignite in the Tatabánya region and the building of a new powerplant in Bicske will enable the aluminum industry to increase its primary aluminum production. The largest smelter is located in Inota, near Várpalota, 75 kilometers southwest of Budapest, where more than half of total Hungarian aluminum is produced.

The capacity and production of Hungarian primary aluminum plants in 1976 are shown in tons in the following tabulation:

	Annual capacity	Production
Inota	46,000	20,000 (ingots), 15,300 (wire).
Ajka	25,000	21,000 (ingots), 1,100 (castings).
Tatabánya	17,000	10,000 (ingots), 1,000 (high-purity ingots). 3,200 (wire).
Total	88,000	

The production of semifinished and finished aluminum products is concentrated at Székesfehérvár, 70 kilometers southwest of Budapest. In 1976, the Székesfehérvár Light Metal Works produced 106,000 tons of aluminum products, representing over

[20] Világgazdaság (World Economy), Budapest. 1977.

[21] Kohászat (Metallurgy), Budapest. V. 108, No. 9, 1975, pp. 415–421.

79% of the entire Hungarian production. The expansion of this plant was completed in July 1976 at a cost of Ftl billion. By the end of the fifth 5-year plan in 1980, the annual capacity of the plant is to be increased to 120,000 tons. A continuous-casting and wire-drawing mill unit is also to be added.[22]

The Köbánya Light Metal Works, located in Budapest, produced an estimated 9,000 tons of aluminum sheet, strip, foil, and pigment paste. According to an agreement signed in 1976 with Japanese Tokai Metals Co., Ltd., production of aluminum foil will be increased from 1,500 tons in 1976 to over 7,000 tons by 1982.[23] Additional capacity for production of semifinished goods is located at Ajka, Inota, and Tatabánya.

Copper.—According to Hungarian sources, production of copper concentrate declined from 7,018 tons in 1975 to 6,794 tons in 1976.[24] Hungary imported 30,248 tons of copper and 12,169 tons of copper products.

There are small copper mines located at Rudabánya (35 kilometers north of Miskolc), Gyöngyösoroszi (20 kilometers southwest of Recsk), and Mecsek (55 kilometers north of Pécs in southern Hungary).

In 1972, a new copper deposit was found in the vicinity of an old one at Recsk in northern Hungary, 145 kilometers northeast of Budapest. The discovery is said to be large, even by international standards, with much of the ore contained in a relatively small area. By 1976, 8-meter-diameter vertical shafts had been sunk to a depth of 1,200 meters. Construction of two connecting haulageways commenced at depths of 700 and 900 meters. By 1985, a 7-million- to 8-million-ton annual capacity mine and a plant to fully process the extracted ore are to be developed.

Gallium.—In 1976, Hungary produced an estimated 2.15 tons of gallium, or around 14% of the world production.[25] The gallium-extracting section of the Ajka alumina plant was developed by Hungarian experts in the early 1970's. By 1977, plans are to produce about 2.8 tons of gallium per year.

The Almásfüzitö alumina plant bought the Soviet technology for gallium production because this method is simpler and less harmful to health than the Hungarian method. By 1979, the first gallium from Almásfüzitö is to enter the internal market and the favorable foreign market.[26]

Iron Ore.—Iron ore production in 1976 was 601,846 tons, a 6.2% decline from that of 1975. About one-half of the output was concentrated iron ore with 42% iron content, and 51% was limonite with 32.6% iron content, resulting in a total of 224,046 tons metal content.[27]

Two-thirds of total national production came from an open pit mine 4 kilometers long and 350 meters deep; the remaining one-third was produced in an underground mine. Because there is little prospect of finding new deposits and present production cannot be expanded, the 4% to 5% share of Hungarian ore in the domestic consumption is expected to decline further.[28]

The only known iron ore reserves are located in Rudabánya, 153 kilometers northeast of Budapest. The known reserves consist of 3.2 million tons of limonite and 14.6 million tons of siderite, giving a total of 17.8 million tons of iron ore reserves, of which 70% is now under exploitation.

To supplement its inadequate production in 1976, Hungary imported over 4 million tons of iron ore from the U.S.S.R. and 157,000 tons from India.[29] Together with other countries in the Council of Mutual Economic Assistance (CMEA), Hungary is participating in the development of iron ore deposits in the U.S.S.R. Once this joint plan is realized, imports of iron ore from the U.S.S.R. will increase.

Iron and Steel.—In 1976, ferrous and nonferrous metallurgy contributed 9.5% to the gross production in Hungary. This was achieved by only 5.9% of the total work force, or 102,400 employees.[30] Investment in ferrous and nonferrous metallurgy in 1976 was around Ft3.7 billion, an 8.8% increase over that of 1975. Iron and steel production represents 70% of all metal-

[22] Work cited in footnote 21.
[23] Világgazdaság (World Economy), Budapest. Dec. 14, 1976, p. 3.
[24] Mining Annual Review, London. 1976, p. 499, and 1977, p. 557.
[25] U.S. Bureau of Mines. Commodity Data Summaries 1977. P. 59.
[26] Népszabadság (People's Freedom), Budapest. July 17, 1977, p. 5.
[27] Kohászat (Metallurgy), Budapest. V. 110, No. 1, 1977, pp. 1-8.
[28] Mining Annual Review, London. 1977, p. 557.
[29] Work cited in footnote 8.
[30] Statistical Pocket Book of Hungary, Budapest. 1977.

lurgical industry. The per capita output of crude steel was 344 kilograms, showing a 1% decline from that of the previous year.

The 1976 production and trade of iron and steel are shown in the following tabulation, in thousand tons:

	1976 [1]	Percent change from 1975	1977 (planned)
Pig iron:			
Production	2,221	+0.1	2,300
Exports	136	+37.4	NA
Imports	288	+13.6	NA
Crude steel:			
Production	3,652	−.6	3,750
Exports	--	--	NA
Imports	7	−63.2	NA
Rolled steel: [2]			
Production	2,857	+6.9	3,000
Exports	1,084	+24.2	NA
Imports	623	−10.1	NA

NA Not available.
[1] Statisztikai Havi Közlemény (Monthly Statistical Publication), Budapest. 1976 and 1977. Külkereskedelmi Statisztikai Évkönyv (Statistical Yearbook of Foreign Trade), Budapest. 1976.
[2] Includes sheet metal and rods.

In 1976, pig iron was produced in nine small blast furnaces. The average dry coke consumption for production of 1 ton of pig iron was 535 kilograms.[31]

Hungarian steel industry technology and most of the equipment at steel plants are outdated. Around 93% of the crude steel in 1976 was produced in open-hearth furnaces, while only 7% came from electric furnaces;[32] only 32% of the Siemen-Martin furnaces are equipped with oxygen injection.

Over 90% of the crude steel production in 1976 came from three metallurgical complexes: 1.2 million tons from the Ózd Metallurgical Works at Ózd (120 kilometers northeast of Budapest, near the Czechoslovak border); 1.2 million tons from the Danube Iron Works in Dunaújváros (60 kilometers south of Budapest on the Danube); and 0.8 million tons from the Lenin Metallurgical Works in Diósgyör (a suburb of Miskolc, 145 kilometers northeast of Budapest).[33] The remaining 10% was produced in Köbánya, Mohács, Szeged, and elsewhere.

In 1976, a new 110-ton-capacity open-hearth furnace was built and a bar/wire-rolling mill was installed at Ózd. The Ft3-billion investment for transformation of the open-hearth furnaces into a modern and more intensive technological operation with oxygen injection is to be completed in 1978. With this, the production of the furnaces can be increased 25% to 30%.

The biggest investment in the metal industry during the present 5-year plan was being made at Dunaújváros. Two 130-ton Linz-Donawitz converters, two 960-cubic-meter blast furnaces, and one 1,700-cubic-meter furnace are to be built by 1980. In addition, a coking plant based on foreign technology is to be completed by 1981, and an ore-dressing plant will be ready by 1983. The estimated initial investment of Ft5.7 billion has been revised to Ft12.9 billion.[34]

With a production of 797,000 tons of steel, the Lenin Metallurgical Works at Diósgyör is the smallest of Hungary's major steelworks. At a cost of Ft10 billion, a new 80-ton-capacity Linz-Donawitz converter, an 80-ton electrofurnace, and continuous-casting facilities are to be completed by 1983. The old open-hearth production is to be completely shut down by that time. With the present electrofurnaces, the capacity of the Lenin Works will increase to 1.1 million tons during the sixth 5-year plan.[35]

The 6.9% increase in rolled steel production was achieved by intensification of work at the existing 20 mills. The 0.5-million-ton production of high-quality steel is concentrated at Dunaújváros, while 83% (0.3 million tons) of the steel pipe is made

[31] Kohászat (Metallurgy), Budapest. V. 109, No. 9 1976. pp. 381–386.
[32] Népszabadság (People's Freedom), Budapest. Aug. 3, 1977, p. 3.
[33] Work cited in footnote 32.
[34] Magyar Hírlap (Hungarian News Bulletin), Budapest. May 28, 1977, p. 7.
[35] Work cited in footnote 34.

at Csepel.[36] With the completion of continuous-casting facilities at Ózd, the share of steel casting in Hungary's steel production reached 26.5%.

Lead and Zinc.—The output of lead and zinc ore and concentrate is as follows, in tons:

	1976 [1]	Percent change from 1975
Lead-zinc ore	143,655	−2.0
Lead concentrate	1,711	−3.5
Zinc concentrate	4,324	+.1

[1] Mining Annual Review, London. 1977, pp. 555–559.

Lead-zinc production is centered at Mátra Mountain, in the northeastern part of Hungary near Gyöngyösoroszi, where a 29-ton-per-hour ore concentration plant is located.[37] Lead production met only 10% of Hungary's needs, and zinc production, only 20%. Consequently, 85% to 90% of the national requirements of both metals must be imported, mostly from the U.S.S.R. Lead and zinc reserves were found in polymetallic ores at Recsk, but the size of the deposits had not been determined.[38]

Manganese.—The 1976 manganese crude ore production in Hungary is shown in the following tabulation:

	Manganese ore [1] (metric tons)	Manganese content [2] (percent)	Percent change from 1975
Oxide	114,450	26.6	−10.3
Carbonate	50,624	18.5	−7.5

[1] Mining Annual Review, London. 1977, pp. 555–559.
[2] Bányászat (Mining), Budapest. V. 109, No. 8, 1976, pp. 186–195.

Hungary exported 13,739 tons of manganese ore, of which 8,517 tons was shipped to Czechoslovakia and 5,222 tons to West Germany; Hungary imported 15,130 tons of manganese ore, all from the U.S.S.R.[39]

Hungary has an estimated 80-million-ton reserve of manganese ore, most of it carbonate.[40] Manganese mines are located near Úrkút (underground) and Csárdahegy (open pit), 120 kilometers southwest of Budapest. Because of inadequate ore beneficiation technology, the carbonate ore is used only as an additive for iron and steel production. There are smaller known reserves of manganese ore near the towns of Eger and Demjén in northeastern Hungary, but these are not presently being mined.

In the near future, an electrolytic ferromanganese furnace is to be erected at Kislöd. Ore production is expected to grow thereby to approximately 500,000 tons per year by the end of the present 5-year plan in 1980.

NONMETALS

Cement.—Cement production in Hungary was 14.3% higher than in 1975, reaching a total of 4,298,000 tons. Consequently, imports of 762,000 tons of cement in 1976 were 22.3% less than in the previous year.[41] Some 42% of the imported cement came from the U.S.S.R., while Romania and East Germany supplied 31% and 26%, respectively. Of 224,000 tons of cement exported, more than 90% was shipped to Yugoslavia.[42]

The first two kilns of a third dry-method cement plant in Bermend came onstream in 1972. The plant, which represents a Ft-2.5-billion investment, is to reach its full capacity of 1.07 million tons in 1977.[43] In 1976, the newest cement plant, located in Hejöcsaba (near Miskolc, 150 kilometers northeast of Budapest), began production. The 1.6-million-ton-capacity plant was built at a cost of Ft4.7 billion. Limestone and clay reserves in the vicinity of Hejöcsaba are sufficient to maintain planned output for 50 years.[44] The fuel used for heating the kiln is natural gas from the U.S.S.R. The plant requires 780 kilocalories (3,095 Btu) to produce 1 kilogram of cement.[45]

A fifth cement plant which is under construction at Bélapátfalva, 115 kilometers from Budapest, is to start production in 1978, and is to reach 1.25-million-ton capacity in the same year.[46] Fuel is alternatively

[36] Közgazdasági Szemle (Review of Economics), Budapest. No. 10, 1976, pp. 1238–1244.
[37] Work cited in footnote 28.
[38] Mining Magazine, London. September 1976.
[39] Work cited in footnote 8.
[40] Kohászat (Metallurgy), Budapest. V. 110, No. 7, 1977, p. 301.
[41] First work cited in footnote 13.
[42] Work cited in footnote 8.
[43] Rock Products. The Hungarian Cement Industry. V. 80, No. 4, April 1977, pp. 114–127.
[44] Work cited in footnote 43.
[45] Építöanyag (Construction Material), Budapest. V. 28, No. 10, 1976, pp. 381–383.
[46] Népszabadság (People's Freedom), Budapest. Apr. 1, 1977, p. 1.

oil or gas, and the product is portland and blended cement.

Clays.—*Bentonite.*—The 1976 production of bentonite declined almost 20%. From 71,148 tons of raw ore, 51,012 tons of processed bentonite was produced in 1976.[47] Hungary exported 18,537 tons of bentonite, of which 83% was shipped to East Germany.[48]

More than 70% of the production came from the open pit mine in Hercegköves, located in northern Hungary. The average 10-meter-thick seam of bentonite lies under 1.5 to 10 meters of overburden. Extraction is accomplished in two benches. A smaller open pit is located in the Rátka-Újhegy area. The entire raw bentonite output is trucked to a milling and processing plant at Mád.[49]

The oldest bentonite mine at Komlóska temporarily ceased production. New reserves found at Ond were being evaluated.[50]

Kaolin.—In 1976, Hungary produced 72,000 tons of kaolin, a 19.1% decline from that of 1975.[51] In the same year, Hungary imported 28,797 tons of washed kaolin and exported 7,235 tons of raw kaolin, three-fourths of which was destined for Czechoslovakia.

Kaolin production is concentrated in the the southern part of the Zempléni Mountains, 180 kilometers from Budapest. The Szegilong and Füzérradvány underground mines and the Bámboby and Királyhegy open pits are the largest of numerous mines in the region. Most of the kaolin reserves in this area are spotty. The main processing plant is located at Bodrogszegi; additional processing capacity and a mill are at Szegi and a mixer at Erdöbénye.[52]

Fertilizer Materials.—In 1976, Hungary produced a gross weight of 3,396,000 tons of mineral fertilizers, a 7.9% increase over that of 1975. Of this quantity, 2,402,000 tons was nitrogen fertilizer and 994,000 tons was superphosphate. Expressed in terms of plant nutrients, the total production in 1976 was 680,000 tons of mineral fertilizers, showing an 8.5% increase over that of 1975.[53]

In 1976, Hungary imported over 2.5 million tons of fertilizers of the following composition: 436,712 tons of nitrogen fertilizer (20.5% nitrogen content), 804,889 tons of phosphatic fertilizer (18% P_2O_5 content), 1,172,083 tons of potash fertilizer (40% K_2O content), and 94,309 tons of combined fertilizers. Of the total fertilizer imports, 34.2% came from the U.S.S.R., 24.9% from East Germany (all potash), and 18% from the United States (all phosphatic).[54]

Since Hungary does not have raw materials for production of potash and phosphatic fertilizers, all potash fertilizer is imported, and the small domestic production of phosphatic fertilizer is based on imported raw materials. In spite of sufficient resources of natural gas, only 62.5% of nitrogen fertilizer was produced domestically.

The largest fertilizer plant is located at Pétfürdö, near Várpalota, 80 kilometers southwest of Budapest. The Pét Fertilizer Complex was commissioned at yearend 1975, but production was hampered by faulty equipment.[55] When fully operational, the plant is to produce 268,000 tons of nitrogen active ingredient, 80,000 tons of P_2O_5, and 80,000 tons of K_2O active ingredient. Other Hungarian fertilizer plants are the Borsod Chemical Combine and the Tisza Chemical Combine, both located near Miskolc, 195 kilometers northeast of Budapest.

Perlite.—The production of perlite in 1976 was 96,180 tons, 33.6% more than in 1975.[56] Perlite is surface mined in the Zempléni Mountains, 200 kilometers northeast of Budapest. The largest mine is located near Pálháza, where extraction is carried out on four benches, each 10 to 12 meters high. Ore is processed locally and shipped to Belegrádpuszta and Zalaegerszeg for bulging.[57] Two-thirds of the final products are exported, mostly to Austria and East Germany.

Refractory Materials.—In 1976, Hungary produced 169,000 tons of chamotte products and 47,000 tons of chrome magnesite products, showing a 1.2% decline and an 11.9% increase, respectively, from the 1975 levels. Imports of refractory materials totaled 42,143 tons, consisting

[47] Work cited in footnote 28.
[48] Work cited in footnote 8.
[49] Bányászat (Mining), Budapest. V. 108, No. 5, 1975, pp. 281–290.
[50] Work cited in footnote 49.
[51] Statisztikai Évkönyv, 1977.
[52] Work cited in footnote 49.
[53] First work cited in footnote 13.
[54] Work cited in footnote 8.
[55] Népszabadság (People's Freedom), Budapest. Apr. 27, 1976, p. 5.
[56] Work cited in footnote 28.
[57] Work cited in footnote 52.

mainly of chrome magnesite products. In 1976, 24,498 tons of refractory materials was exported.[58] Because of inadequate domestic resources of magnesite, 70% of the basic materials are imported.[59] Half of the output is used in metallurgy, 18% is used in construction, 11% is exported, and the rest is used in 75 other industrial branches.[60]

Future plans include construction of a new aluminum silicate plant at Encs, located in Borsod County, 180 kilometers northeast of Budapest. The projected capacity is to reach 170,000 tons in 1983 and the projected cost is Ft3 billion. Plans also include setting up a synthetic magnesite facility at Tiszavárkony, but as of 1976 the project had not been approved.

MINERAL FUELS

Hungary's primary energy consumption in 1976 reached an estimated 45 million tons standard coal equivalent, representing a 7.7% increase over that of 1975. Coal provided 38% of total primary energy, oil 37.6%, natural gas 22.4%, hydroelectric and imported energy 1.1%, and fuelwood 0.9%. In 1976, 58.4% of Hungary's primary energy consumption came from indigenous fossil fuels. Imports accounted for 42.7% and exports for 1.1% of the total primary energy available in 1976. The total energy balance for 1975 and 1976 is shown in table 4.

Substantial efforts to explore additional energy sources characterized 1976. Coal prospecting was concentrated around Tatabánya. Oil and gas prospecting centered around Szeged in the south. The urgency of locating new energy sources is reflected in the current 5-year plan, in which one-third of all industrial investment is related to energy. Exploration is carried out by Országos Földtani Kutató és Fúró Vállalat (National Geological Exploring and Drilling Enterprise) (OFKFV), which is capable of drilling up to 80,000 meters per year.

In its 27 producing, processing, and supply enterprises, the OKGT employs around 51,000 people. Future investments to be completed during the present 5-year plan are the Szeged oil and gas processing complex by 1977, expansion of storage capacity at the Tisza Petroleum Enterprise by 580,000 cubic meters, the gas pipeline network, building of underground gas storage, building of the Adriatic petroleum, pipeline, and an Ft1.3-billion program for environmental protection. The objective of the 5-year plan is to search for an additional 30 million to 35 million tons of hydrocarbons, for which an estimated 1,000 kilometers of drilling is foreseen.

Coal.—In 1976, total production of coal in Hungary was 25,257,000 tons, of which 11.6% was bituminous, 58.5% brown, and 29.9% lignite. Of the total production,

[58] Work cited in footnote 8.
[59] Népszabadság (People's Freedom), Budapest. Mar. 17, 1977, p. 5.
[60] Work cited in footnote 59.

Table 4.—Hungary: Primary energy balance for 1975 and 1976

(Million tons of standard coal equivalent [1])

Year	Total primary energy	Coal (lignite, anthracite, bituminous), coke, and briquets	Crude oil and petroleum products	Natural and associated gas	Fuelwood	Hydroelectric and other power
1975:						
Production	r 24.2	14.0	r 2.9	6.9	0.4	--
Imports	r 18.2	r 2.7	r 13.5	1.1	--	0.9
Exports	r .6	.1	r .3	--	--	.2
Apparent consumption	r 41.8	r 16.6	r 16.1	8.0	.4	.7
1976: [p]						
Production	26.3	14.3	3.1	8.5	.4	--
Imports	19.2	2.9	14.2	1.6	--	.5
Exports	.5	.1	.4	--	--	--
Apparent consumption	45.0	17.1	16.9	10.1	.4	.5

[p] Preliminary. [r] Revised.
[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories. Conversion factors used are: Hard coal, 1.0; lignite and brown coal, 0.5; recovered slurries, 0.515; briquets and household coke, 0.67; coke, 0.9; crude oil, 1.47; refinery products, 1.53; natural gas, 1.33 (per thousand cubic meters); manufactured gas, 0.6; and hydroelectric power, 0.125 (per thousand kilowatt-hours).

76% came from underground mines, and the remaining 24% came from open pit mines.[61] In the same year, Hungary exported 55,000 tons of brown coal, 16,345 tons of coal briquets, and 5,000 tons of industrial and household coke. Imports during the year consisted of 1,297,000 tons of bituminous and anthracite coal, 1,360,000 tons of metallurgical coke, 514,704 tons of coal briquets, and 98,000 tons of industrial and domestic coke.[62]

Hungary has an estimated 20 billion tons of explored and recorded coal reserves,[63] representing around 86% of all energy reserves. The estimated composition of coal reserves is bituminous 25%, brown 48%, and lignite 27%.[64] Coal production is divided into nine independent enterprises, supervised by the MSZT.

With an output of 6.2 million tons of lignite (involving 31 million cubic meters of overburden removal), the Thorez open pit mine at Visonta, located 80 kilometers northeast of Budapest, is the largest mine in Hungary. In 1976, over 3,500 people were employed at this mine.[65] The average heating value of the lignite ranged from 1,450 to 1,500 kilocarlories per kilogram (2,610 to 2,700 Btu per pound). Explored reserves at Visonta were estimated at 186 million tons of lignite.[66] The entire production is used locally in the Gagarin Thermal Powerplant.

The largest coal mining area is located in northern Hungary, 130 kilometers from Budapest. Recoverable reserves in the Borsod area were estimated at 360 million tons of brown coal, covering an area of 650 kilometers.[67] In 1976, the production from 15 mines in the Borsod coal mining region was around 5.2 million tons of brown coal. Over 19,000 people were employed there and of these about 47% were underground miners.[68] The quality of coal varies with the depth of the mine, which ranges from 110 to 458 meters. Some indication of the quality may be seen from the following: Calorific value 2,000 to 3,600 kilocalories per kilogram (3,600 to 6,240 Btu per pound), 12.5% to 38% ash content, 3.2% to 8.6% sulfur, and 29.5% to 34.5% moisture.[69] In the same year, mechanization of production stood at 66% of stoping and 73% of loading. Some 52% of the extraction was done by the longwall system.[70] Three of the least productive mines are to be closed in 1977. During the 5-year plan, three-fourths of the Ft1.8-billion investment in coal mining is to be spent on new machinery.[71]

During the current 5-year plan, Hungary is to spend Ft1.2 billion to explore undeveloped coal reserves. Ft7 billion is to be spent on the development of new mines at known deposits. Four new mines are to be developed in the Tatabánya-Oroszlány coal region. The Márkushegy mine, with a projected output of 6,000 tons per day, is to be developed by 1981. It will be followed by the Nagyegyháza mine (6,000 tons per day), the Mány mine (14,000 tons per day), and the Lencsehegy mine (2,000 tons per day).[72] By 1986, when all four mines are developed, the design capacity of 8 million tons per year should be reached, a level that could be maintained for at least 40 years. The opening of these mines is coordinated with the construction of a 1,930-megawatt-capacity thermal powerplant in Bicske,[73] 35 kilometers west of Budapest. Explored coal reserves in this area were estimated at 400 million tons of lignite, having a calorific value of around 4,000 kilocalories per kilogram (6,200 Btu per pound).[74]

In addition to the above, there are two other lignite deposits large enough to fuel power stations. One is in the area of Bükkábrány-Emöd near Miskolc, where the feasibility of building a 2,000-megawatt powerplant is now being investigated. The second is in the area around the town of Torony, near Szombathely, where preliminary research indicates enough lignite reserves to fuel a 1,500- to 2,000-megawatt powerplant.[75]

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[61] Work cited in footnote 5.
[62] Work cited in footnote 8.
[63] Work cited in footnote 75.
[64] Köolaj és Földgáz (Crude Oil and Natural Gas), Budapest. V. 110, No. 8, 1977, p. 229.
[65] Work cited in footnote 64.
[66] Bányászat (Mining), Budapest. V. 109, No. 4, 1976, p. 287.
[67] Népszabadság (People's Freedom), Budapest. Aug. 11, 1977, p. 9.
Bányászat (Mining), Budapest. V. 109, No. 6, 1976, pp. 369–382.
[68] First work cited in footnote 67.
[69] Bányászat (Mining), Budapest. V. 108, No. 4, 1975, pp. 211–223.
[70] First work cited in footnote 67.
[71] Népszabadság (People's Freedom), Budapest. Jan. 27, 1977, p. 9.
[72] Mining Annual Review, London. 1977, p. 557.
[73] European Coal Information Agency, Brussels. No. 2, 1977, p. 9.
[74] Horník a Energetik (Miner and Energy), Praha. June 23, 1977, p. 5.
[75] Pages 197–199 of work cited in footnote 63.
Magyar Hírlap (Hungarian News Bulletin), Budapest. June 1, 1976, p. 7.

The joint Hungarian-Polish enterprise Haldex, recovering coal from spoil banks, has processed some 42 million tons of spoil, from which 4.8 million tons of coal, 4.2 million tons of raw material used as concrete aggregate, 3 million tons of material for the ceramic industry, and 3 million tons of rock have been recovered during 16 years of operation. By the end of 1977, the sixth Haldex plant, with a capacity of 240 tons per hour, should come into operation.

Construction of the No. 3 coking battery of Hungary's largest coking plant, located at Dunaújváros, began in 1976. The plant will be supplied with coking coal from the Mecsek region, and by 1980 it is to produce 640,000 tons of blast furnace coke per year.[76] Because of inadequate reserves of coking coal, Hungarian experts are experimenting with production of form coke, using lignite and bituminous coal of lesser quality.[77]

In 1977, the MSZT is to produce 25.1 million tons of coal.[78] The quality of coal is expected to continue to decline. Investments in 1977 will be concentrated on the development of new mines in the Tatabánya region, replacement of old mining machinery, and extension of mechanization in all coal mining.

Natural Gas.—The 1976 gas production in Hungary was 6,081 million cubic meters, 17.4% over that of 1975 and almost 5% over the planned amount.[79] A total of 1,208 million cubic meters of natural gas was imported in 1976, of which 1,000 million came from the U.S.S.R., 200 million from Romania, and 8 million from Czechoslovakia. In addition, Hungary imported nearly 24,000 tons of liquefied gas from the U.S.S.R. and East Germany. Exports amounted to 9 million cubic meters of natural gas and 44,766 tons of liquefied gas.[80] Gross reserves in place of natural gas were estimated at 100 billion cubic meters.[81]

The largest gas-producing area is located in southern Hungary around Szeged and Algyö, where reserves were estimated at 45 billion cubic meters.[82] The 1976 production reached 3,600 million cubic meters, representing 59% of the total natural gas production in Hungary.[83] The second largest gas-producing region is located at Hajduszoboszló, 180 kilometers east of Budapest, where natural gas production in 1976 amounted to 1,460 million cubic meters.[84] Additional gasfields are located at Szank, 50 kilometers northwest of Szeged, where reserves were estimated at 5.5 billion cubic meters;[85] smaller fields are located at Kardoskút, Békés, Berekfürdö, and Kiskunhalas. Exploratory drilling was carried out in Gyor-Sopron County, 100 kilometers west of Budapest, and in the valley of the Dráva River, at the Yugoslav border.[86] With the exception of Szeged and Szank, the older gasfields are rapidly being depleted. Consequently, during the fifth 5-year plan, equipment for secondary extraction is to be installed.

Consumption of town gas in 1976 was 638 million cubic meters, and is slowly declining as more cities are being connected to the natural gas network. Budapest and Szombathely will be converted to natural gas by 1980, and the remaining five cities, during the following 5-year plan.[87]

In order to narrow the difference between annual and peak consumption, a special storage facility was built in 1975 at Szeged, and two underground storage facilities are planned for the fifth 5-year plan. By 1985, the Hajduszoboszló I and Pusztaederics underground storage facilities are to be completed, with a combined capacity of 650 million cubic meters. Together with the future storage facilities in Kardoskút, Szank, and Hajduszoboszló II, the total storage capacity should reach more than 2 billion cubic meters.[88]

At the beginning of 1976, the 800-millimeter-diameter Friendship gas pipeline was completed, connecting Zsámbok and Budapest. The high-pressure pipeline network, with a total length of nearly 3,000 kilometers, is connected to the Czechoslovak network as a security measure in case of emergency. In addition to extending the

[76] Magyar Hírlap (Hungarian News Bulletin), Budapest. Mar. 17, 1977, p. 7.
[77] Müszaki Élet (Technical Life), Budapest. Nov. 5, 1976, p. 6.
[78] Népszabadság (People's Freedom), Budapest. Jan. 1, 1977, p. 1.
[79] First work cited in footnote 13.
[80] Work cited in footnote 8.
[81] Közgazdasági Szemle (Review of Economics), Budapest. No. 4, 1972, pp. 462–475.
[82] Köolaj és Földgáz (Crude Oil and Natural Gas), Budapest. V. 107, No. 11, 1974, pp. 333–338.
[83] Népszabadság (People's Freedom), Budapest. Nov. 30, 1976, p. 9.
[84] Népszabadság (People's Freedom), Budapest. July 16, 1977, p. 5.
[85] Köolaj és Földgáz (Crude Oil and Natural Gas), Budapest. V. 109, No. 8, 1976, pp. 233–238.
[86] Magyar Hírlap (Hungarian News Bulletin), Budapest. Feb. 15, 1976, p. 15.
[87] Figyelö (Observer), Budapest. May 5, 1976, pp. 1–2.
[88] Pages 464–475 of work cited in footnote 81.

national pipeline network, the existing pipelines for town gas are being converted to carry natural gas.

The biggest processing enterprise is located at Szeged, where the largest share of natural gas is produced. In addition to the 1-million-cubic-meter-per-day older plant, there are two new primary gas-processing plants with a total capacity of 8 million cubic meters per day. The second stage of the enterprise, a plant for processing the liquids separated from the gas, should have been finished in 1976, but completion was postponed to 1977 owing to late delivery of equipment. Other gas-processing plants are located in Hajduszoboszló (4 million cubic meters per day), Kardoskút (2 million cubic meters per day), and Szank (1 million cubic meters per day).

The 1977 plans include production of 6.1 billion cubic meters of natural gas and 237,000 tons of liquefied gas, and the addition of 22,000 consumers to the natural gas distribution network.[89] Together with other CMEA countries, Hungary is participating in the construction of the Orenburg pipeline in the U.S.S.R. Hungary is responsible for a 500-kilometer section, running from Orenburg to Aleksandrova Gai, containing three compressor stations at Chust, Bogoradsani, and Gusyatin. In exchange for its participation, after completion of the pipeline in 1979, Hungary is to receive 2.8 billion cubic meters of Soviet natural gas annually.

Petroleum.—Crude oil production in 1976 reached 2,142,000 tons, a 6.8% increase over that of 1975.[90] Of the 8,785,000 tons of imported oil, 87.9% came from the U.S.S.R. and the remaining 12.1% came from Iraq and Iran. In addition, Hungary imported 864,065 tons of refinery products. Exports consisted of 277,191 tons of refinery products, 67% of which was sold to Austria.[91] Some 10,927,000 tons of crude oil was refined in 1976; the refined products included 2,165,000 tons of gasoline, 3,509,000 tons of fuel oil, and 3,360 tons of gas oil.[92]

Hungary's production of petroleum is centered around Szeged-Algyö, close to the Yugoslav-Romanian border. In 1976, three-quarters of the entire output was produced there, and by 1977 it is to increase to 87%.[93] At yearend 1976, there were 720 oil and gas wells either producing oil or pumping gas or water for secondary production.[94] About 200,000 tons of oil was produced from under the city of Szeged using inclined drilling, piped to Móraváros for storage, and piped from there to Algyö. Of the neighboring fields, only Asotthalom and Kelebia were producing on a commercial scale. Because of faulty and obsolete equipment, the Kiszombor, Móraváros, and Ferencszállás Fields, with a potential annual production of more than 500,000 tons, were still not producing.[95] This temporary shortcoming was offset by putting the Endröd, Karastarcsa, and Kiskunhalas Fields into operation.[96]

Secondary production at the Lovászi Field, located in the western portion of Hungary, began in 1976. Carbon dioxide, piped from the nearby Budafa gasfield, was injected into depleted fields. According to plans, 40 existing wells will begin this type of secondary production, which should yield 360,000 tons of crude oil by 1985.[97]

Hungarian imports of crude oil come through the Friendship I and II pipelines. The Friendship I was opened in 1962 and runs from Sahy in Czechoslovakia to Százhalombatta, with a pumping station in Gödöllö; the 400-millimeter-diameter pipeline carries around 4.5 million tons of oil per year. The Friendship II pipeline, with a 600-millimeter diameter and an annual capacity of 10 million tons of crude oil, was commissioned in 1972. The 290-kilometer pipeline runs from Ungvár, on the Hungarian-Soviet border, to Százhalombatta, with a pumping station in Fényeslitke. In addition, there is a pipeline connecting Százhalombatta with Algyö and Szöny. Three main oil product pipelines connect Százhalombatta with Leninváros, Pécs, and Székesfehérvár.

Nearly 11 million tons of crude oil was refined in Hungary in 1976. With an annual capacity of 7 million tons of crude oil, the Danube Petroleum Enterprise (Dunai Köolojipari Vállalat) in Százhalombatta is the largest supplier of fuel oils and lubri-

[89] Népszabadság (People's Freedom), Budapest. Jan. 30, 1977, p. 1.
[90] First work cited in footnote 13.
[91] Work cited in footnote 8.
[92] First work cited in footnote 13.
[93] Work cited in footnote 83.
[94] Világgazdaság (World Economy), Budapest. Nov. 1, 1976, p. 3.
[95] Work cited in footnote 83.
[96] Magyar Hírlap (Hungarian News Bulletin), Budapest. Feb. 24, 1977, p. 7.
[97] Népszabadság (People's Freedom), Budapest. July 13, 1977, p. 9.

cants in Hungary. In 1976, there were about 30 units in operation, the latest ones being the ortho-xylol and aromatic extraction plants completed in 1976.[98] The second largest refinery is now being built in Leninváros, 170 kilometers northeast of Budapest on the Tisza River. Tiszai Köolajfinomitö (Tisza Refinery) (TIFO) is to be finished by 1978 at a cost of Ft6.5 billion.[99] Projected capacity is 3 million tons of crude oil, imported from the U.S.S.R. It will supply mazout to the neighboring powerplant and industrial-grade gasoline to the Tisza Chemical Combine for further processing.[1]

The 2-million-ton-annual-capacity refinery near Komárom is now under reconstruction. Work on the first stage, which includes the replacement of a 1-million-ton-capacity distillation unit at a cost of Ft1.1 billion, began in 1976.[2] After completion of this work in 1980, new large-capacity units are to be built. The two smallest refineries are located in Zalaegerszeg and Nyírbogdány, having annual capacities of 0.7 million tons and 0.3 million tons, respectively.

The future plans of the Hungarian oil industry include intensification of oil production in the Szeged-Algyö area, connection of smaller fields (Kiszombor and Ferencszállás) with a collection station at Algyö, and continuation of exploratory drilling, not only in the Szeged-Algyö region but in other parts of Hungary as well. Construction of the Adria pipeline, originating at the Yugoslav port of Bakar on the island of Krk, is to start in 1977. Through the 600-millimeter-diameter pipeline, 10 million tons of crude oil is to be piped annually to Hungary, half of which is to be shipped to Czechoslovakia.

Nuclear Power.—Work was proceeding on the nuclear powerplant at Paks on the Danube River, 120 kilometers south of Budapest. The first of the four 440-megawatt Novovoronezh-type light-water reactors is scheduled to begin operation in 1979. The second block is to start up in 1981, the third in 1983, and the fourth in 1984, reaching a planned capacity of 1,760 megawatts. By 1990, total capacity of this powerplant is to reach 4,000 megawatts with the help of 1,000-megawatt Leningrad-type units. The design and construction of this powerplant was being carried out under a Soviet-Hungarian cooperation agreement. About 30% of the equipment is to be provided by Hungary while the rest is to come from the U.S.S.R.[3]

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[98] Hungarian Foreign Trade, Budapest. No. 3, 1977.
[99] Page 1 of work cited in footnote 97.
[1] Népszabadság (People's Freedom), Budapest. Dec. 13, 1974, p. 5.
[2] Világgazdaság (World Economy), Budapest. Aug. 18, 1976, p. 3.
[3] Hungarian Foreign Trade, Budapest. No. 2, 1976, pp. 16–17.

The Mineral Industry of Iceland

By Joseph B. Huvos [1]

In 1976, Iceland had only a small mineral production. Hydroelectrical and geothermal energy were abundant, and there were plans to expand their use. Imported alumina was reduced to aluminum, and there was minor production of nonmetallic minerals, including diatomite (about 1.3% of the world total), cement, fertilizer materials, sand and gravel, and stone. In 1976, the gross national product (GNP) was about $1.3 billion;[2 3] the aluminum industry contributed about 2.6% of this value and nonmetallic minerals, about 1.7%.

Several important events occurred in the mineral industry during 1976. Construction of the Sigalda hydroelectric project was completed. Construction continued on Icelandic Alloys' ferroalloy project and on the Government's Krafla geothermal generating station in northern Iceland. Pilot development on a perlite project and planning of the Blanda and Hrauneyjafoss hydroelectric projects continued. An earthquake damaged Johns-Manville Corp.'s diatomite mine. Discussions continued on expanding Icelandic Aluminium Co. Ltd.'s reduction plant.

PRODUCTION

There was gradual improvement in Iceland's economy in 1976, in which aluminum and other mineral products shared. Production of mineral commodities is detailed in table 1, and the following tabulation shows the major producers of mineral commodities:

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Icelandic kronor (Ikr) to U.S. dollars at the rate of Ikr182.17=US$1.00.

[3] U.S. Department of Commerce. Foreign Economic Trends and Their Implications for the United States: Iceland. November 1976, p. 2.

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	Icelandic Aluminium Co. Ltd., plant at Straumsvik, Alusuisse (Switzerland).	100
Cement	State Cement Works, plant at Akranes, Government	100
Diatomite	Kisilidjan, H.F., mine at Myvatn, Government 25% and Johns-Manville Corp. (United States) 48%.	100
Fertilizers	State Fertilizer Plant, Gufunes, Government	100

Table 1.—Iceland: Production of mineral commodities

Commodity and unit of measure	1974	1975	1976 p
Aluminum metal, primary ---------- metric tons--	69,600	61,800	65,300
Cement, hydraulic ---------- thousand metric tons--	101	159	145
Diatomite [1] ---------- metric tons--	24,055	20,264	22,699
Fertilizer materials, manufactured, gross weight:			
Nitrogenous ---------- do----	4,476	9,680	12,892
Other ---------- do----	r 30,794	25,184	29,866
Pumice [1] ---------- do----	6,930	3,540	1,529
Sand and gravel:			
Calcareous ---------- thousand cubic meters--	119	110	105
Other ---------- thousand metric tons--	561	e 500	513
Stone:			
Dimension ---------- do----	e 90	NA	NA
Crushed and broken ---------- do----	486	33	28
Scoria ---------- do----	94	92	93

e Estimate. p Preliminary. r Revised. NA Not available.
[1] Exports.

TRADE

There was no significant change in the pattern of Iceland's foreign trade in 1976. Mineral commodity exports were mainly aluminum (16.8% of total exports),[4] scrap, and diatomite. Mineral imports were mainly petroleum products, alumina, cryolite, and salt. Iceland's mineral commodity trade in 1974 and 1975 is shown in table 2.

[4] News from Iceland (Reykjavík). July 1977, p. 8.

Table 2.—Iceland: Mineral commodity trade

(Metric tons unless otherwise specified)

Commodity	1974	1975
EXPORTS		
METALS		
Aluminum metal including alloys, unwrought	63,071	43,636
Iron and steel scrap	5,276	3,455
Nonferrous metal scrap and metal-bearing residues	490	--
NONMETALS		
Diatomite	24,055	20,264
Pumice	6,930	3,540
IMPORTS		
METALS		
Aluminum:		
Alumina	195,209	169,919
Metal including alloys:		
Unwrought	65	30
Semimanufactures	1,410	950
Chromium oxide and hydroxide	5	--
Copper metal including alloys, unwrought and semimanufactures	118	244
Iron and steel metal:		
Scrap	497	--
Pig iron, ferroalloys, similar materials	98	219
Steel, primary forms	r 539	1,392
Semimanufactures:		
Bars, rods, angles, shapes, sections	23,185	18,612
Universals, plates, sheets	13,938	9,936
Hoop and strip	632	410
Rails and accessories	4	--
Wire	336	467
Tubes, pipes, fittings	7,210	5,450
Total	45,305	34,875
Lead:		
Oxides	18	--
Metal including alloys:		
Unwrought	60	--
Semimanufactures	3	--
Mercury, 76-pound flasks	6	--
Nickel metal including alloys, all forms	1	--
Platinum-group and silver metals including alloys:		
Platinum-group, value, thousands	$80	$78
Silver, do	$304	$268
Tin, unwrought and semimanufactures	10	--
Titanium oxides	529	641
Tungsten metal including alloys, all forms, value	r $671	--
Zinc:		
Oxide	14	--
Metal including alloys:		
Blue powder	2	--
Unwrought	42	43
Semimanufactures	48	46
Other:		
Oxides, hydroxides, peroxides of metals, n.e.s	4	--
Metals including alloys, all forms:		
Metalloids	20	39
Base metals including alloys, all forms, n.e.s	(1)	56
NONMETALS		
Abrasives, natural, n.e.s	27	15
Asbestos	8	--
Barite and witherite	26	--
Boron materials	3	--
Cement, hydraulic	32,098	80,423
Chalk	261	--
Clays and clay products (including all refractory brick):		
Crude	281	317
Products:		
Refractory (including nonclay bricks)	685	1,495
Nonrefractory	1,117	813
Cryolite and chiolite	535	361
Diamond, all grades, value	r $310	--
Diatomite and other infusorial earth	(1)	--

See footnotes at end of table.

Table 2.—Iceland: Mineral commodity trade—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
NONMETALS—Continued			
Fertilizer materials:			
Crude		8	--
Manufactured:			
Nitrogenous		102	125
Phosphatic		1,093	896
Potassic		7,395	3,873
Other, including mixed		24,234	32,182
Ammonia		2,672	1,927
Gypsum and plasters		8,691	10,986
Lime		1,316	1,086
Mica, all forms		9	--
Pigments, mineral, including processed iron oxides		43	641
Precious and semiprecious stones, except diamond	value, thousands	$13	--
Salt and brine		67,051	56,829
Sodium and potassium compounds, n.e.s		356	335
Stone, sand and gravel:			
Dimension stone		117	--
Worked		35	34
Dolomite, chiefly refractory grade		2,146	--
Gravel and crushed rock		106	--
Limestone		444	--
Quartz and quartzite		r 51	--
Sand, excluding metal bearing		r 106	--
Sulfur, all forms [2]		415	--
Talc, steatite, pyrophyllite		82	--
Other:			
Crude		7	--
Oxides and hydroxides of magnesium, strontium, barium		3	--
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s		548	842
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		662	--
Carbon black and gas carbon		1	--
Coal, coke, peat		225	--
Hydrogen, helium, rare gases	value	$1,711	--
Petroleum refinery products:			
Gasoline, motor	thousand 42-gallon barrels	626	742
Kerosine and jet fuel	do	547	401
Distillate fuel oil	do	2,696	2,453
Residual fuel oil	do	738	543
Lubricants	do	54	39
Mineral jelly and wax	do	2	1
Other:			
Liquefied petroleum gas	do	9	12
Nonlubricating oils, n.e.s	do	8	10
Pitch coke	do	7	10
Bitumen and other residues	do	46	72
Unspecified	do	2	4
Total	do	4,735	4,287
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		579	232

r Revised.
[1] Less than ½ unit.
[2] Mainly sulfuric acid.

COMMODITY REVIEW

METALS

Aluminum.—The Swiss aluminum company Alusuisse discussed with the Icelandic Government expansion of its 35,000-ton-per-year Straumsvik, Hafnarfjordur, reduction plant, which was operated by its subsidiary, Icelandic Aluminium. Electrical power for the project was to be allocated from the Sigalda hydroelectric station, located about 160 kilometers east of Reykjavík and operated by Iceland's National Power Company.

The aluminum market improved significantly in 1976; 65,300 tons of primary metal was produced, leaving only 6,000 tons of unsold stock.

Ferroalloys.—After Union Carbide Co. dropped participation in a ferrosilicon project with the Icelandic Government, the Government started new negotiations with Elkem-Spigerverket A/S of Norway, involving financing of the project through the Nordic Investment Bank. During 1976, the plant site was under preparation on the northern shore of Hvalfjördhur; construction was to start in 1977 and be completed by 1979.

NONMETALS

Diatomite.—In 1976, an earthquake and a lava eruption damaged the Johns-Manville-operated diatomite mine near Krafla, north of Lake Mývatn. The company is a minority partner (48%) with the Icelandic Government in the mine and processing plant. The plant is supplied with process steam and electrical power from the nearby Námafjall geothermal field.

Perlite.—In 1976, the Industrial Development Institute of Iceland operated a pilot project for mining a perlite deposit at Prestahnúkur Mountain, about 100 kilometers inland from Reykjavík; the deposit contained about 48 million tons of raw ore. Ore beneficiation and expanding tests were performed at the State Cement Works at Akranes near Reykjavík.[5]

MINERAL FUELS

Energy.—In 1976, hydroelectrical and geothermal power supplied almost one-half of Iceland's energy needs. The rest was supplied by imported petroleum products from Western Europe and the U.S.S.R. There were no petroleum refineries in the country, and only inferior-quality coal and peat were known to exist. Iceland's supply and apparent consumption of fuel and power in 1975 and 1976 are shown in table 3.

[5] Industrial Minerals. May 1977, pp. 25–26.

Table 3.—Iceland: Supply and apparent consumption of fuel and power in 1975 and 1976

(Million tons of standard coal equivalent [1])

	Total primary energy	Coal and coke	Petroleum and refinery products	Hydroelectrical power	Geothermal energy
1975:					
Production [2]	0.7	([3])	--	0.3	0.4
Imports	.9	--	0.9	--	--
Exports	--	--	--	--	--
Apparent consumption	1.6	([3])	.9	.3	.4
1976: [p]					
Production [2]	.7	--	--	.3	[e].4
Imports	.8	--	.8	--	--
Exports	--	--	--	--	--
Apparent consumption	1.5	--	.8	.3	.4

[e] Estimate. [p] Preliminary.
[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Includes only primary energy.
[3] Less than ½ unit.

Sources: Statistical Bureau of Iceland. Statistical Bulletin. V. 46, No. 1, February 1977.
Geothermal Energy Magazine. V. 3, No. 11, November 1975, p. 11.

Geothermal.—Work continued in 1976 on construction of the 55-megawatt geothermal power station at Krafla north of Lake Mývatn; damage during construction by a lava flow and an earthquake delayed indefinitely the commissioning of the plant.

Owing to its location on the mid-Atlantic Ridge, Iceland has a very high geothermal potential, estimated at 3,200 megawatts.[6] At present, about 315 megawatts (thermal) is utilized, including about 254 for space heating, 40 in agriculture, 18 in industry, and 3 for generating electrical power at Námafjall.

Hydroelectrical.—In 1976, installed hydroelectrical generating capacity was approximately 550 megawatts-electric, or 10% of the country's potential. Major facilities were the 210-megawatt-electric complex at Búrfell, about 130 kilometers east of Reykjavík, which was completed in 1970, and the recently completed 150-megawatt-electric Sigalda complex, about 30 kilometers farther inland. Construction was to begin in 1977 on a 210-megawatt-electric plant, 5 kilometers downstream from Sigalda at Hrauneyjafoss. Under consideration was construction of a 150-megawatt-electric powerplant on the Blanda River in the north.

[6] Geothermal Energy Magazine. V. 5, No. 5, May 1977, p. 21.

The Mineral Industry of India

By Gordon L. Kinney [1] and Francis E. Shafer [2]

The Indian economy recorded little change during fiscal year 1976.[3] Overall growth of the gross national product (GNP) was 1.6% in constant 1970 prices. In current prices, India's GNP was $90.7 billion.[4 5] The small increase in the GNP at constant prices, coupled with a population growth of over 2.0%, led to a virtual stagnation in the per capita GNP ($91.84 in 1976 versus $92.40 in 1975). India's population at the end of calendar year (CY) 1976 was estimated at 616 million and was increasing by about 12 million persons each year, the equivalent of adding annually the population of Venezuela or Malaysia. India's agricultural sector continued to be a key factor in the overall economy, accounting for 44% of the GNP. The second consecutive good summer monsoon had a favorable impact on food grain yields. The 1976 harvest exceeded 111 million tons, second only to 1975's record 121 million tons (revised). Prospects looked good for 1977, and another favorable monsoon could push food grain production near or above the 1975 record.

The industrial production index for 1976 showed a record high 10.4% increase, owing primarily to greater capacity utilization of existing plants, especially in the public sector, and to a generally quiet labor situation. The number of productive man-days lost because of labor disputes declined significantly during 1976 but may increase again during 1977 because continued inflation and a gradual decline in purchasing power was causing renewed restiveness among the labor unions at yearend.

Low investment in the private sector continued to be a problem for Indian industry despite Government attempts to stimulate it. Another problem facing the industrial sector was the chronic shortage of electric power. The shortages have adversely affected overall industrial output, especially in the aluminum, iron and steel, and cement industries. The agricultural sector was not seriously affected because it was given priority and was therefore not subjected to power cuts or periods of load-shedding. It is estimated that in 1977 the difference between demand and available supply will be about 7 billion kilowatt-hours. The power shortage has persisted in spite of an 8% increase in India's installed capacity to 23,700 megawatts in 1976 (well below the target of 25,700 megawatts). Power generation increased over 11% to 89 billion kilowatt-hours.

An ambitious power development program is being conducted by the Government of India. It calls for an increase in installed capacity to 45,000 megawatts by 1983. This target growth will be expensive and difficult to achieve, with over half of the increased capacity to be fired by thermal powerplants using noncoking Indian coal. The World Bank, the Organization of Petroleum Exporting Countries (OPEC) Special Fund, and several foreign countries are to assist in the new power projects.

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[1] Physical scientist, International Data and Analysis.

[2] Regional resources attaché, U.S. Department of State, New Delhi, India.

[3] The Indian fiscal year is the year beginning Apr. 1 of that stated. Hereafter, fiscal year will be assumed unless calendar year is specified.

[4] Where necessary, values have been converted from Indian rupees (Rs) to U.S. dollars at the rate of Rs8.80=US$1.00.

[5] U.S. Embassy, New Delhi, India. Indian Economic Data. April 1978, pp. 1–24.

PRODUCTION

Total mineral production value was estimated at over $1.4 billion in 1976 or about 1.5% of the GNP. Bituminous coal was the leading mineral with nearly 60% of the total value, followed by petroleum and natural gas with around 20%, metallic minerals with 12%, and nonmetals with about 8%. Iron ore accounted for about one-half of the metals value, and limestone and phosphate rock together accounted for nearly three-fourths of the nonmetals value.

Production of the more important minerals except chromite and mica increased. Mica production dropped about 28%, and chromite production declined 20% from the CY1975 record high. Despite the drop in chromite production, the minehead value increased to about $22 million from $18 million in 1975 because of large world price increases.

India was one of the world's major bituminous coal producers. The CY1976 production of 101 million tons ranked about fifth in the world. Of major interest was India's unusual speed in bringing its first offshore oilfield into production. The first oil strike at the field was made in February 1974 and commercial oil flowed from it in May 1976. By yearend 1976, the field was producing at a rate of 16,000 barrels per day.

Of India's 30 states and territories, Assam, Bihār, Gujarāt, Madhya Pradesh, and West Bengal States together accounted for nearly 80% of the total mineral production value. Bihār alone contributed over 30%, mainly coal, iron ore, copper, and bauxite. Most of Gujarāt's and Assam's value was derived from their crude oil and natural gas output.

Table 1.—India: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum:			
Bauxite, gross weight ---thousand tons	[r] 1,114	1,273	1,448
Alumina, gross weight ---do	299	337	442
Metal, primary	[r] 128,917	159,678	211,835
Antimony metal, regulus	393	238	404
Cadmium metal	59	53	84
Chromium, chromite, gross weight	396,535	500,294	402,118
Copper:			
Mine output, metal content	28,080	39,000	49,800
Metal:			
Smelter	[r] 11,000	22,000	24,800
Refined	[r] 11,772	16,344	20,028
Gold, smelter ---troy ounces	101,114	90,826	100,696
Iron and steel:			
Iron ore and concentrate, gross weight ---thousand tons	35,485	41,405	42,330
Pig iron [2] ---do	7,342	8,385	9,751
Ferroalloys:			
Ferrochrome	15,300	10,128	17,059
Ferromanganese	146,015	142,398	175,506
Ferrosilicon	29,682	39,972	53,970
Ferrosilicochrome	1,312	3,200	5,002
Other	[r] 332	339	303
Steel ingot [3] ---thousand tons	6,820	7,802	8,354
Steel castings ---do	[r] 62	60	61
Semimanufactures: [4]			
Angles, shapes, sections ---do	807	893	908
Bars and rods ---do	2,223	2,315	2,544
Plates and sheets:			
Uncoated ---do	649	815	970
Galvanized ---do	152	163	178
Tinplate ---do	78	107	114
Hoop, strip, skelp ---do	449	650	1,076
Rails and accessories ---do	355	318	381
Wire ---do	220	266	311
Special steels, form not specified ---do	364	218	420
Total ---do	5,297	5,745	6,902
Lead:			
Mine output, metal content	[r] 9,147	11,111	13,320
Metal, primary	3,986	4,769	5,435
Manganese ore and concentrate, gross weight ---thousand tons	[r] 1,502	1,576	1,760

See footnotes at end of table.

Table 1.—India: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS—Continued			
Rare-earth metals, monazite concentrate, gross weight [e]	[r] 3,000	[r] 3,000	3,000
Silver, mine and smelter output thousand troy ounces	[r] 147	83	102
Titanium: [e]			
Ilmenite concentrate, gross weight	[r] 132,000	[r] 82,000	82,000
Rutile concentrate, gross weight	[r] 5,800	[r] 3,600	3,600
Tungsten, mine output, metal content	12	20	23
Zinc:			
Mine output, metal content	19,257	22,838	25,560
Metal	21,105	25,727	26,785
Zircon [e]	[r] 10,300	[r] 10,300	10,300
NONMETALS			
Abrasives, natural, n.e.s.:			
Corundum, natural	[r] 337	311	528
Garnet	[r] 3,702	4,437	2,032
Asbestos	[r] 23,272	19,957	22,648
Barite	[r] 143,541	175,275	235,000
Cement, hydraulic thousand tons	14,265	16,176	18,640
Chalk	[r] 54,336	45,069	61,009
Clays:			
Ball clay	[r] 22,396	25,941	29,652
Diaspore	[r] 3,122	2,564	10,029
Fire clay	[r] 802,000	650,000	617,075
Kaolin:			
Crude, directly salable thousand tons	[r] 315	260	298
Processed do.	[r] 111	97	98
Total do.	[r] 426	357	396
Other do.	229	165	229
Diamond:			
Gem [e] thousand carats	18	17	17
Industrial [e] do.	3	3	3
Total do.	21	20	20
Diatomite	50	--	--
Feldspar	[r] 54,496	42,472	53,413
Fertilizer materials:			
Crude, phosphatic:			
Apatite	[r] 12,034	30,338	38,180
Phosphate rock	[r] 433,438	429,049	644,119
Manufactured: [4 5]			
Nitrogenous: [6]			
Gross weight thousand tons	2,767	3,462	4,120
N content do.	1,030	1,300	1,608
Phosphatic: [7]			
Gross weight do.	838	467	790
P_2O_5 content do.	135	75	127
Mixed: [8]			
Gross weight do.	843	1,118	1,419
N content do.	156	208	254
P_2O_5 content do.	196	245	351
K_2O equivalent content do.	80	93	144
Fluorspar:			
Crude:			
Acid grade	4,714	4,961	9,701
Metallurgical grade	5,995	5,256	2,706
Total	10,709	10,217	12,407
Concentrates (graded)	3,749	3,067	3,451
Gem stones, excluding diamond:			
Agate (including chalcedony pebble)	[r] 988	1,588	2,541
Emerald, crude carats	[r] 2,990	38,280	825
Garnet kilograms	[r] 632	420	3,538
Graphite	[r] 26,456	30,897	32,515
Gypsum thousand tons	1,073	815	711
Kyanite and related materials:			
Kyanite	[r] 45,337	52,364	45,432
Sillimanite	[r] 2,950	8,278	14,758
Lime	[r] 384,000	380,000	182,000
Magnesite	[r] 265,582	313,453	328,747
Mica, processed:			
Exports:			
Blocks	940	574	889
Splittings	6,172	3,484	3,530
Condenser film	175	135	150
Washers and disks	198	99	151
Waste and scrap	18,952	22,456	8,055

See footnotes at end of table.

Table 1.—India: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
NONMETALS—Continued				
Mica, processed—Continued				
Exports—Continued				
Powder		[r] 9,080	7,878	9,239
Micanite and other built-up mica		21	14	33
Cut sheets and strips		NA	37	47
Other		10	3	53
Total		35,548	34,680	22,147
Domestic use [e]		10,800	10,000	10,000
Grand total		46,348	44,680	32,147
Pigments, natural, mineral: Ocher		[r] 80,500	98,495	87,455
Pyrite:				
Gross weight		35,660	50,633	51,951
Sulfur content		[r] 13,110	18,822	19,222
Salt, all types	thousand tons	[r] 5,916	6,168	4,836
Stone, sand and gravel:				
Calcite		[r] 25,336	13,690	20,661
Dolomite	thousand tons	[r] 1,195	1,450	1,739
Limestone	do	[r] 25,816	26,061	29,009
Quartz and quartzite	do	[r] 323	321	370
Sand:				
Calcareous	do	729	902	1,072
Other	do	[r] 1,439	1,585	1,726
Slate		[r] 4,905	3,417	3,650
Talc and related materials:				
Pyrophyllite		[r] 15,562	14,994	32,728
Steatite (soapstone)		[r] 293,000	213,000	209,000
Vermiculite		[r] 2,895	2,111	3,901
Wollastonite		[r] 954	1,102	3,495
MINERAL FUELS AND RELATED MATERIALS				
Carbon black [e]		[r] 65,000	[r] 52,000	59,000
Coal:				
Bituminous	thousand tons	84,102	95,931	101,036
Lignite	do	3,044	2,822	3,895
Total	do	87,146	98,753	104,931
Coke:				
Coke oven and beehive	do	8,199	8,846	[e] 9,000
Gashouse	do	45	50	[e] 50
Other, soft [e]	do	[r] 3,700	3,700	3,700
Total	do	[r] 11,944	12,596	12,750
Gas, natural:				
Gross	million cubic feet	[r] 67,716	81,585	85,108
Marketable [9]	do	25,320	35,244	53,784
Petroleum:				
Crude	thousand 42-gallon barrels	55,733	61,611	64,632
Refinery products:				
Gasoline	do	10,965	10,396	11,169
Jet fuel and kerosine	do	22,367	25,307	27,980
Distillate fuel oil	do	53,100	53,175	54,518
Residual fuel oil	do	28,258	33,859	32,947
Lubricants	do	2,772	2,485	2,380
Other	do	23,610	25,069	27,991
Refinery fuel and losses	do	7,173	10,917	11,067
Total	do	148,245	161,208	168,052

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, bromine, other clays (bentonite, fuller's earth, and common clay), other gem stones (aquamarine, ruby, and spinel), and uranium are also produced, but production is not reported and available information is inadequate for formulation of reliable estimates of output levels. In 1975, production of 6,514 metric tons of uranium ore containing about 3 metric tons of U_3O_8 was reported from two mines, but this output was only a portion of total national production.

[2] Data are for calendar years; data for fiscal years beginning Apr. 1 of years stated are as follows, in thousand metric tons: 1974—7,736. 1975—8,340, and 1976—10,022.

[3] Data are for calendar years; data for fiscal years beginning Apr. 1 of years stated are as follows, in thousand metric tons: 1974—7,186, 1975—7,910, and 1976—9,731.

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

[5] Data are from: Fertilizer Association of India. Fertilizer Statistics, 1977–78 (New Delhi). 1978, pp. I/37–I/39 and I/178–I/179.

[6] Includes ammonium sulfate, ammonium sulfate-nitrate, urea, calcium ammonium nitrate, and ammonium chloride.

[7] Includes single superphosphate, pelophos, and triple superphosphate.

[8] Includes all reported varieties of nitrogenous-phosphatic and nitrogenous-phosphatic-potassic (NP and NPK) mixed fertilizers.

[9] Includes reinjected gas.

TRADE

India's world trade continued to grow at a steady rate. Total foreign trade of about $12 billion amounted to about 13% of India's GNP in 1976.

There was a dramatic reversal in India's balance-of-trade situation in CY1976. Imports dropped in value about 4% while the value of exports increased a substantial 28%. According to preliminary data, trade was nearly in balance in 1976, compared with the $1,438 million (revised) deficit in 1975. Exports and imports are expected to be about in balance in 1977.

The total value of India's exports in 1976 was $5.9 billion, of which about $1.3 billion or 22% was accounted for by the mineral industry. Nonmetal exports were valued at about $640 million and metal exports at about $630 million. Japan was by far India's largest mineral purchaser with 43% of the total. The five leading mineral exports in value were iron ore and concentrate ($280 million), cut diamonds ($220 million), chromite ($30 million), mica ($27 million), and manganese ($18 million).

The total value of imports in 1976 was $5.97 billion, down slightly from the 1975 figure of $6.2 billion (revised). Mineral imports were valued at $1.6 billion, with petroleum again the dominant item. Imports from Iran, Saudi Arabia, Iraq, and Abu Dhabi accounted for over 80% of the total import value. Although metal imports have dropped in the last few years, nonmetal imports other than petroleum, particularly uncut diamonds, have increased. India is mining and processing domestically a higher proportion of its mineral requirements than it has in the past. In terms of value, only petroleum imports have continued a steady increase, because of rising international prices and increased demand.

Table 2.—India: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum:			
Bauxite and concentrate		14,320	21,190
Aluminum oxide and hydroxide		42,817	40,699
Metal including alloys:			
Unwrought		15	34,814
Semimanufactures		3,448	6,357
Cadmium metal including alloys, all forms		--	45
Chromium ore and concentrate		350,128	277,798
Copper:			
Copper sulfate		1	[1]
Metal including alloys:			
Unwrought		10	[1]
Semimanufactures		558	691
Iron and steel:			
Iron ore [2]	thousand tons	21,821	22,990
Iron ore concentrate	do	975	414
Scrap	do	126	218
Pig iron, shot, pellets	do	210	856
Ferroalloys:			
Ferrochrome		3,115	4,823
Ferromanganese		2,001	24,154
Ferrosilicon		--	8,316
Steel ingot and equivalent primary forms	thousand tons	118	298
Semimanufactures:			
Bars, rods, angles, shapes, sections	do	143	948
Plates and sheets	do	2	15
Hoop and strip	do	[1]	[1]
Rails and accessories	do	[1]	77
Wire	do	2	3
Pipes, tubes, fittings	do	99	230
Castings and forgings, rough	do	7	6
Lead:			
Oxides		187	23
Metal including alloys, all forms		38	170
Manganese ore and concentrate:			
First-grade ore		81,983	29,812
Second-grade ore		196,826	222,270
Ferruginous ore [3]		514,530	462,356

See footnotes at end of table.

Table 2.—India: Exports and reexports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS—Continued		
Manganese ore and concentrate—Continued		
Manganese oxide	584	24
Other	20	--
Nickel metal including alloys, all forms	13	5
Selenium, elemental ---kilograms--	--	(1)
Silicon, elemental ---do---	3,668	--
Silver metal including alloys ---thousand troy ounces--	42,323	40,875
Tin metal including alloys, all forms	4	27
Titanium ore and concentrate:		
Ilmenite	68,975	120,727
Other	1,300	300
Tungsten metal, all forms ---kilograms [4]--	133	7
Zinc:		
Oxide	55	235
Metal including alloys, all forms	537	9
Other:		
Ores and concentrates:		
Of rare-earth metals	310	--
Of vanadium, molybdenum, columbium, tantalum, zirconium	2,510	--
Oxides and hydroxides, n.e.s	158	300
Metal-bearing residues	268	458
Base metals including alloys, all forms, n.e.s	--	57
NONMETALS		
Abrasives:		
Natural emery, crude	96	32
Natural, n.e.s	5	117
Dust and powder of natural or synthetic gem stones, except diamond	--	220
Abrasive wheels, stones, powder	1,026	2,122
Asbestos	38	49
Barite and witherite	173,610	151,426
Boron materials, boric acid	117	146
Cement, hydraulic	338,055	619,728
Chalk	263	1,167
Clays and clay products (including all refractory brick):		
Crude:		
Ball clay	73	--
Bentonite	9,665	12,631
Earth clay	280	(1)
Fire clay	940	266
Fuller's earth	110	21
Kaolin	1,818	3,778
Other	404	889
Products:		
Refractory (including nonclay refractory products)	14,065	16,681
Nonrefractory	[5] 931	[5] 16,599
Diamond, gem:		
Uncut ---value, thousands--	$462	$109
Cut ---do---	$101,785	$209,303
Feldspar	6,509	11,983
Fertilizer materials: Ammonia, anhydrous and aqueous ---value--	$284	$2,390
Gem stones, except diamond:		
Natural:		
Uncut:		
Emerald ---value, thousands--	$768	$645
Feldspar ---do---	$9	--
Other ---do---	$4,599	$3,802
Cut ---do---	$16,881	$19,028
Synthetic and reconstituted:		
Uncut ---do---	$19	$51
Cut ---do---	$232	$1,826
Graphite, natural	50	14
Gypsum and plasters	97	974
Kyanite and related materials:		
Kyanite, calcined	7,082	5,295
Kyanite, other	16,498	6,096
Sillimanite	100	455
Other	2	26
Lime, hydraulic, and quicklime	1,393	5,383
Magnesite:		
Crude	35	108
Calcined, excluding dead-burned	9,339	7,790
Dead-burned	352	342

See footnotes at end of table.

Table 2.—India: Exports and reexports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
NONMETALS—Continued		
Mica:		
Crude:		
Blocks	574	889
Condenser film	126	146
Splittings	3,484	3,530
Waste and scrap	22,456	8,055
Manufactured:		
Condenser film plates	9	4
Washers and disks	99	151
Cut sheets and strips	37	47
Micanite and other built-up mica	14	33
Powder	7,878	9,239
Other	3	53
Pigments, mineral:		
Natural, not further described	394	331
Iron oxide	3,696	3,215
Salt	328,199	356,984
Sodium and potassium compounds, n.e.s.:		
Caustic soda	7,244	3,759
Caustic potash	119	344
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked:		
Slate	63	1,101
Marble	561	1,345
Other	53,932	150,060
Worked, all types	2,915	4,231
Crushed and broken stone and gravel:		
Dolomite	3,369	5,945
Limestone for lime manufacture	121,258	219,172
Quartz	2,929	6,520
Other	467	1,252
Sand, excluding metal bearing	5,898	229
Sulfur:		
Elemental	327	322
Sulfuric acid	2,466	989
Talc, steatite, soapstone	7,157	8,785
Other:		
Crude	1,901	3,791
Slag and wastes, not metal bearing	42	622
Oxides and hydroxides of strontium, barium, magnesium	58	370
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	45,693	17,195
Carbon black	1,792	3,306
Coal:		
Bituminous	417,279	470,220
Other	7,817	7,308
Coke	15,389	24,313
Petroleum refinery products: [6]		
Gasoline ---thousand 42-gallon barrels	14	NA
Kerosine and jet fuel ---do	105	NA
Distillate fuel oil ---do	122	NA
Residual fuel oil ---do	--	NA
Lubricants ---do	69	NA
Other ---do	975	NA
Total ---do	1,285	([6])
Crude chemicals produced from the distillation of coal, petroleum, and/or natural gas	69,316	1,305

NA Not available.

[1] Less than ½ unit.

[2] Includes manganiferous iron ore containing up to 10% Mn.

[3] 10% to 35% Mn grade.

[4] Incorrectly reported as metric tons in previous edition.

[5] Partial figures; exclude materials not reported quantitatively, valued at [r] $76,990 in 1975 and $89,440 in 1976.

[6] Source for 1975 data is U.S. Bureau of Mines International Petroleum Annual, 1975. Official trade statistics do not report petroleum refinery products by categories listed. Instead, all products are listed in three categories as follows, in metric tons: 1975—light distillates, [r] 26,003; medium distillates, [r] 77,578; and other, [r] 40,980; and 1976—light distillates, 28,666; medium distillates, 52,778; and other, 65,046.

Table 3.—India: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum:		
Alumina	491	361
Metal including alloys, all forms	8,577	2,029
Antimony:		
Ore and concentrate, gross weight	723	1,523
Oxides	39	45
Metal including alloys, all forms	11	46
Arsenic:		
Crude sulfides	2	8
Oxides and acid	484	836
Elemental	15	22
Beryllium metal including alloys, all forms ---kilograms---	1,232	615
Bismuth metal including alloys, all forms	1	2
Cadmium metal including alloys, all forms	6	(1)
Chromium:		
Oxide and hydroxide ---kilograms---	5	400
Metal including alloys, all forms	50	61
Cobalt:		
Oxide and hydroxide	6	7
Metal including alloys, all forms	110	59
Copper:		
Ore and concentrate	25,368	--
Metal including alloys:		
Scrap	1,138	7,113
Unwrought	17,639	31,185
Semimanufactures	3,437	2,515
Iron and steel:		
Iron ore	--	178
Roasted pyrite	--	3
Metal:		
Scrap	15,714	28,135
Pig iron, sponge iron, iron and steel powder	492	535
Ferroalloys	865	794
Steel ingot and equivalent primary forms	25,073	12,372
Semimanufactures:		
Bars, rods, angles, shapes, sections	108,845	58,688
Sheets and plates	469,477	255,956
Hoop and strip	25,689	15,452
Rails and accessories	9	25
Wire	4,267	2,679
Pipes, tubes, fittings	81,817	88,026
Castings and forgings, rough	10,120	5,859
Lead:		
Ore and concentrate	30	145
Oxide	40	18
Metal:		
Unwrought	21,340	46,144
Semimanufactures	171	235
Magnesium metal including alloys, all forms	256	296
Manganese:		
Ore and concentrate	5,430	190
Oxides	22	38
Metal including alloys	112	87
Mercury ---76-pound flasks---	7,016	9,531
Molybdenum metal including alloys, all forms	43	106
Nickel:		
Matte	(1)	--
Metal including alloys:		
Scrap	221	852
Unwrought	3,144	2,792
Semimanufactures	1,868	1,731
Platinum and silver:		
Waste and scrap	8	12
Platinum metal, unwrought and semimanufactures ---troy ounces---	17,079	18,022
Silver metal, unwrought and semimanufactures ---do---	21,561	56,814
Rare-earth metals ores and concentrates	--	15
Selenium, elemental	7	2
Silicon, elemental	1,119	605
Tantalum metal including alloys, all forms ---kilograms---	825	180
Tin:		
Oxide	10	11
Metal including alloys:		
Scrap	2,025	4,127
Unwrought	2,316	3,111
Semimanufactures	3	3
Titanium oxide	2,573	4,068

See footnotes at end of table.

Table 3.—India: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS—Continued		
Tungsten:		
Ore and concentrate	216	500
Metal, all forms	59	34
Zinc:		
Ore and concentrate	23,079	38,493
Oxide	--	11
Dust	1,126	590
Metal including alloys:		
Unwrought	37,892	47,829
Semimanufactures	59	688
Other:		
Ores and concentrates of vanadium, molybdenum, columbium, tantalum, zirconium	37	90
Scrap and other wastes, n.e.s	3	1
Metalloids, n.e.s	35	23
Metals, unwrought and semimanufactures, n.e.s	64	328
NONMETALS		
Abrasives:		
Tripoli earths	18	2
Other, natural	--	2
Dust and powder of natural or synthetic gem stones, except diamond ----kilograms	83	546
Grinding and polishing wheels and stones	730	464
Asbestos	41,515	47,167
Boron materials:		
Crude, natural	15,929	11,498
Boric acid	30	3
Bromine, elemental	--	230
Cement	--	702
Clays and clay products (including all refractory brick):		
Crude:		
Ball clay	721	465
Bentonite	7	17
Earth clay	279	1
Fire clay	--	186
Fuller's earth	143	231
Kaolin	10	5
Other	397	103
Products:		
Nonrefractory	[2] 17	249
Refractory	4,547	10,903
Diamond:		
Gem ----value, thousands	$82,962	$156,252
Industrial ----thousand carats	795	480
Diatomite (kieselguhr and infusorial earth)	1,391	1,251
Fertilizer materials:		
Crude, natural: Phosphate rock ----thousand tons	567	472
Manufactured:		
Nitrogenous: [3]		
Ammonium nitrate, ammonium sulfate, and urea, N content ----do	1,375	974
Other, gross weight	425,837	43,220
Phosphatic	65,548	5,028
Potassic	311,350	258,876
Mixed	705,834	30,894
Fluorspar, cryolite, chiolite	4,206	4,062
Gem stones, except diamond, uncut:		
Natural:		
Emerald ----value, thousands	$4,876	$6,698
Feldspar ----do	$7	$120
Other ----do	$545	$445
Synthetic and reconstituted ----do	$89	$65
Graphite, natural	404	647
Gypsum and plasters	8	45
Iodine, elemental (except colloidal)	340	97
Lime, hydrated, and quicklime	--	9
Magnesite, crude	21	--
Mica, worked	81	30
Pigments, mineral:		
Iron oxide	928	1,063
Other	252	152
Pyrite, gross weight	--	6
Salt	399	252
Sodium and potassium compounds, n.e.s.:		
Caustic soda	([1])	50
Caustic potash and potassium and sodium peroxide	5	196

See footnotes at end of table.

Table 3.—India: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1975	1976
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		33	[4] 66
Worked	value	--	$1,111
Dolomite, chiefly refractory grade		--	2
Gravel and crushed stone:			
Quartz	value	$25,678	$30,275
Other		1	8
Sand, excluding metal bearing		[5] 11	--
Sulfur:			
Elemental		617,074	588,741
Sulfuric acid		9	([1])
Talc, steatite, soapstone, pyrophyllite		17	11
Other:			
Crude nonmetallic ores		9,143	9,717
Slag and ash, not metal bearing		--	28
Oxides and hydroxides of barium, strontium, magnesium		101	107
Fluorine and colloidal iodine		11	2
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s		407	1,144
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		523	281
Carbon black and gas carbon:			
Carbon black		1,291	1,094
Gas carbon		3	5
Coal, anthracite		2,485	35
Coke, all types		75	--
Petroleum:			
Crude	thousand 42-gallon barrels	100,918	98,753
Refinery products:			
Gasoline	do	332	--
Kerosine and jet fuel	do	5,092	5,324
Distillate fuel oil	do	4,267	4,304
Residual fuel oil	do	5,548	5,495
Lubricants	do	553	350
Other	do	--	1,340
Total	do	15,792	16,813
Crude chemicals derived from the distillation of coal, petroleum, and/or natural gas		11,832	3,294

[1] Less than ½ unit.
[2] Excludes quantity valued at $3,525.
[3] Some nitrogenous fertilizers are reported in terms of N content and others in terms of gross weight; thus they cannot be added.
[4] Excludes quantity valued at $170.
[5] Excludes quantity valued at $282.

COMMODITY REVIEW

METALS

Aluminum and Bauxite.—The Indian aluminum industry had a mixed year in 1976. Aluminum production started strong but was again hampered by severe electric power shortages toward yearend. In contrast, reserves of bauxite, the principal ore of aluminum, took a major upturn.

Bauxite production for the calendar year increased about 14% to 1,448,000 tons valued at over $4 million at the mine. Average pithead prices rose from $2.70 to $2.84 per ton. Alumina production increased significantly to 442,000 tons, of which Bharat Aluminium Co. Ltd. (BALCO) exported 40,000 tons which earned $4.5 million in foreign exchange.

Total production of aluminum metal in CY1976 was 211,835 tons, which would have been higher except for the electric power supply problems. Installed capacity increased to 299,000 tons per year with the completion of the second potline at BALCO's Korba aluminum smelter. It was not commissioned, however, because of the power shortage. At yearend, indications were that the 55 megawatts of power needed to operate the line would be available in mid-1977, and the outlook for the third and fourth potlines under construction was that power would be available by

March 1978 and December 1978, respectively, at the earliest.[6]

The huge bauxite deposits discovered in the Eastern Ghats Range near Visākhāpatnam were under detailed investigation during 1976 by the Geological Survey of India (GSI) and the Government-owned Minerals Exploration Corp. (MEC). The bauxite exists over an area of potentially 25,000 square kilometers. The deposits parallel the coast starting north of the Godāvari gorge upstream of Rājahmundry, extending northeast through Andhra Pradesh into Orissa, over a length of 300 kilometers and a width of 40 to 100 kilometers.[7]

MEC was conducting detailed exploration on proving specific deposit conditions, tonnages, and assays. One of the features of the deposits was that the ore, which varies in thickness from 6 to 51 meters, is near the surface and often has virtually no overburden. So far, the grade of the deposits has ranged from 42% to 55% Al_2O_3 (with much of it exceeding 48%), a favorable 2% to 4% SiO_2 and 1% to 4% TiO_2, and 19% to 22% iron content. A breakdown of bauxite reserve figures by class was not available at yearend, and different sources gave various figures. However, the totals for Orissa ran as high as 1.3 billion tons with a cutoff grade of 40% Al_2O_3 and less than 5% SiO_2. The reserves of adjacent Andhra Pradesh State were put at around 750 million tons.

Considering the new finds, total bauxite reserves for the country could increase from 1.4 billion tons to about 2.4 billion tons, putting India about fourth in world reserves.

As a result of these highly favorable findings and the good potential for establishing nearby hydroelectric or thermal powerplants, BALCO was considering various schemes for development of the deposits. It plans to set up export-oriented alumina-aluminum complexes, together with associated power and caustic soda production facilities.

Plans called for a minimum of two 600,000-ton-per-year alumina plants. The Indian Government was anxious to use these resources to the greatest benefit of the country by processing the ores and making alumina or aluminum metal, rather than exporting the relatively low-value bauxite. The furthest advanced plan was that for a complex to mine and process the Orissa ores. There would be a 600,000- to 800,000-ton-per-year alumina plant, a 150,000- to 200,000-ton-per-year smelter, a captive 500-megawatt powerplant, and a 200- to 400-ton-per-day caustic soda plant with downstream utilization of the chlorine discharge. The output of the smelter and the surplus alumina would be exported, earning considerable foreign exchange. Several foreign companies were reportedly interested in participating in the plans. Financing and details of the $1 billion project were still to be decided.

Plans for a second project, to be located at Golukonda in Andhra Pradesh, were still in the early stages. Basically, a 600,000-ton-per-year alumina plant would be built, with the entire output exported until a second smelter could be completed.

India's aluminum metal exports for April through September 1976 reached a new high of $20 million, exceeding the previous record for the entire year of 1975. Principal items exported were ingot and electric-conductor-grade wire, bar, and rod. Among the principal buyers were Bangladesh, Sri Lanka, Hong Kong, Libya, Indonesia, Kuwait, and Iraq. As demand rises in India, especially for conductor-grade aluminum, there will be less available for the export market. The Government began a ban on ingot exports but not on fabricated items. Any additional problems with the electric power supply would almost certainly cause domestic shortages and a complete ban on aluminum exports.

Chromite.—Production of chromite declined to about 402,000 tons in CY1976, about 20% below the CY1975 record high. The minehead value, however, was nearly $22 million, ranking chromite sixth in mineral value in India for the year. About 97% of India's chromite production came from Orissa State, with most of that originating at nine mines, three State-owned and six privately owned. Except for the Byapur underground mines, chromite mining was open pit and labor intensive, employing about 6,000 workers.

Although the Government officially banned the export of high-grade ore to conserve the limited supply, the State-

[6] Government of India. Ministry of Steel and Mines, Department of Mines (New Delhi). Report 1976–77, pp. 49–51.
[7] Work cited in footnote 6.

owned Orissa Mining Corp. was permitted to export some chromite of all grades on an ad hoc basis in 1976. There appeared to be some flexibility in the export ceiling depending on the local supply and demand situation. Chromite exports totaled 278,000 tons valued at $30 million in CY1976, compared with 350,000 tons valued at $21 million in CY1975. The 43% value increase, despite the 21% tonnage decline, reflected the large world price increases in 1976. Japan continued as the principal recipient of Indian chromite, accounting for about 86% of the exports in 1976. The United States, Switzerland, the Republic of Korea, and Taiwan received the remainder.

Indian chromite reserves (27% to 52% Cr_2O_3 content) were revised upward from 13.8 million tons in 1973 to over 17 million tons in 1976. Orissa State possessed about 73% of the total reserves, which were composed of 4.2 million tons proved, 2.36 million tons indicated, and 10.7 million tons inferred. An intensive exploration and drilling program was conducted during the year by GSI to further delineate India's chromite deposits. The 17-million-ton reserve figure was computed with a 40-meter-depth limit, generally considered the limit for economical recovery in the Indian deposits. However, with pithead prices jumping from $19 per ton in 1975 to $48 per ton in 1976, the depth at which economical retrieval would be possible will increase. Sample borings detected chromite at 108 meters, a depth which could be exploited if the deposit was rich enough. A further large increase in reserves was expected when the drilling program is concluded.

Two other noteworthy developments occurred during the year. The State-owned Mysore Minerals Ltd. announced plans to build a 6,000-ton-per-year charge chrome plant at Byapur in the Hassan District of Karnataka. Charge chrome is a high-carbon ferrochromium containing 3% to 6% silicon. The plant would be built with Japanese collaboration and would be the first of its kind in India. Secondly, the Government began studying the economic viability of a 50,000-ton-per-year high-carbon ferrochromium plant in Orissa. The plant would utilize chromite fines from the Sukinda deposit and probably would be a joint venture between the Federal and State Governments.

Copper.—India has always been poor in known copper deposits, but persistent exploration efforts were beginning to reveal a number of modest-size occurrences that have the potential for economical exploitation.

In an effort to minimize dependence on imports, Hindustan Copper Ltd. (HCL) was organized in 1967 with the responsibility of developing the various copper deposits found in different parts of the country. Subsequently, Indian Copper Corp. Ltd. in Bihār was taken over by the Government and entrusted to HCL in 1972. Since then copper has been a fully nationalized industry.[8]

HCL's current responsibilities include the copper complex at Ghātsīla and the Rakha copper project, both in Bihār; the Khetri copper complex and the small copper mines at Dariba and Chandmari in Rājasthān; and the Agnigundala lead-copper project in Andhra Pradesh. In addition, HCL was planning the development of the Malanjkhand copper deposit in the Bālāghāt District of Madhya Pradesh.

Copper deposits have been reported in 11 of the states, but most of India's known reserves are in Bihār, Rājasthān, and Madhya Pradesh. Total reserves (proved, indicated, and inferred) in these three States are reported as 322 million tons or 91% of the national total. Grades ranged from 0.4% to 2.5% copper content with some deposits not economically exploitable under present or near future conditions.

GSI reported two recent copper finds in Karnataka that are apparently high-grade vein deposits; one is at Aladahalli near Tiptūr, and the other is in Hassan District. As these are the first known occurrences of base metals in the "peninsular gneiss formation," the possibility exists that further exploration in this formation may uncover additional deposits.

Several interesting copper discoveries were reported in Rājasthān during 1976. They were located at Padarkipal in Dūngarpur District, Basantgarh and Derhi in Sirohi District, and Khankhera in Bharatpur District. Details of the reserves were not yet known, and exploratory drilling was still in progress at yearend.

The Kesapura deposit in the Mayurbhanj District of Orissa was discovered by GSI.

[8] Pages 52–56 of work cited in footnote 6.

About 1.7 million tons of chalcopyrite ore at a 0.7% copper cutoff grade has been proved. The average grade was 1.59% copper. The deposit was turned over to MEC for detailed delineation of the ore body.

A copper, lead, and zinc deposit at Ambaji in the Banaskāntha District of Gujarāt was being examined by a technical team from a British firm. The firm will prepare a feasibility report on reserves and suitability of the ore for beneficiation. MEC did the original exploration and reported over 8 million tons of ore with a total metal content of over 12% lead, zinc, and copper.

The $102 million development project at the Malanjkhand copper deposit in Bālāghāt District, Madhya Pradesh, was finally approved in February 1977. The long-awaited project was delayed in October 1976 pending clarification of the reserve and ore-grade figures. The mine will be a mechanized, hard-rock, open pit operation capable of producing 1 million tons of ore per year when commissioned, with output gradually increasing to 2 million tons by 1984. The concentrator will have the same capacity and will supply the Khetri smelter. It was reported that Soviet technical assistance would be provided for the design and development of the mine. Design and preparatory work was expected to take about 16 months.[9]

Improvements were underway or authorized at several of the mines supplying India's two copper smelters, Ghātsīla in Bihār and Khetri in Rājasthān, which have a combined annual capacity of 57,000 tons.

The Mosaboni mine was to be expanded from 2,200 tons to 3,200 tons per month at a cost of nearly $7 million. A system for increasing ore production at the Surda mine from 400 tons to 1,300 tons per day was sanctioned in July 1976 at a cost of about $3.4 million. The new capacity will come from increased mechanization of the underground workings and a change from timbered breast stoping to more efficient and faster mining methods.

The phase two expansion of the Rakha mine was in the final planning stages. The mine output would be increased from 1,000 tons to 6,000 tons per day at a cost of $5.6 million. Phase one construction at Rakha was completed in October 1975 at a cost of $11.6 million. The Mosaboni, Surda, and Rakha mines all supply copper concentrate to the Ghātsīla smelter.

Production at the Khetri and Kolihan underground mines increased to over 3,500 tons per day from an average of 2,500 tons per day in 1975.

At the underground Dariba mine, ore production was over 40,000 tons during 1976, exceeding the design capacity of the mine by 10,000 tons.

The Chandmari mine near Khetri Nagar in Rājasthān began operation in December 1975, 4 months ahead of schedule, at a rate of 100 tons of ore per day. By July 1976, a production rate of 500 tons per day was attained. Chandmari was India's first open pit, hard-rock copper mine. A $3 million plan to expand its production to 1,000 tons per day was sanctioned in July 1976.[10]

The Khetri, Kolihan, and Chandmari mines all supply ore for concentration to the Khetri copper complex. Production of blister copper at Khetri during 1976 fell to 7,800 tons from the 9,200 tons produced in 1975.[11] This decline was caused by a variety of technical and operational problems at the smelter, particularly with the flash furnace that produces the copper matte. Operations at the byproducts complex, however, ran smoothly during the year, with sulfuric acid production more than doubling to over 37,000 tons. Production of single superphosphate fertilizer began in October 1976, and a phosphoric acid plant was under construction at yearend. The Khetri complex will ultimately produce over 19,000 tons of triple superphosphate per year.

Total ore production for 1976 increased 31% to about 2.36 million tons. Output of blister copper at the two smelters increased slightly to nearly 25,000 tons. Production should improve markedly in the next few years if the problems at Khetri can be solved and when the increased ore production from the mine expansions begins to be available. The production target for 1977 was set at 36,000 tons of blister copper.

Indian demand for copper was estimated at 50,000 tons in 1976, with imports, including semimanufactures and alloys, reportedly at more than 40,000 tons. Although

[9] Work cited in footnote 8.
[10] Engineering and Mining Journal. News Briefs, India. V. 177, No. 10, October 1976, p. 144.
[11] Work cited in footnote 8.

the Government was striving for self-sufficiency in copper, demand was increasing along with the improved supply. Thus, India will find it difficult and expensive to attain this objective in the near future.

Iron Ore.—Iron ore continued to be one of the main minerals produced in India, exceeded in value only by coal and petroleum and natural gas during 1976. There are three categories of iron ore mines in India: Captive mines, owned and operated by the large integrated steel plants; public-sector mines, run by State mining corporations and the National Mineral Development Corp. (NMDC), a subsidiary of the Steel Authority of India, Ltd. (SAIL); and the smaller, privately owned mines, excavated by both mechanized and manual methods. Of the 392 mines reportedly operating at the beginning of 1976, 18 were in the captive category and accounted for about one-third of total production. There were apparently 351 private-sector mines, most located in or near Goa. They were generally small but together provided an additional one-third of the production, nearly all of which was direct-shipping ore for the export market.

Massive hematite deposits were the only important source of iron ore in India during the year. However, other common types of iron mineralization are known in India, with banded magnetite-quartzite and goethite both occurring in considerable tonnages. India's measured reserves of hematite were put at over 4 billion tons, with total reserves of all classes estimated to exceed 10 billion tons. India ranked fifth in the world in recoverable reserves. One-half of the total reserves were located in Bihār and Orissa States and were estimated to grade over 55% iron, of which over 1.8 billion tons was expected to grade over 62% iron.

Magnetite reserves were much smaller and mostly of lower iron content. Measured reserves were put at 1.2 billion tons and the total of all classes at 2.75 billion tons. The magnetite deposits are well suited to beneficiation by grinding, magnetic separation, and agglomeration. There was no commercial exploitation during the year, but the extensive Kudremukh deposit in Karnataka State was under development.

Production was about 4% higher than in 1975, increasing to an estimated 43 million tons valued at roughly $93 million at the mine. This ranked India eighth in world production of iron ore with 5% of total world output. Most production was from open pit operations. Value of the ore at the mine was reported to average $2.11 per ton for the public-sector mines and $1.33 per ton for the private-sector mines.[12]

NMDC was the largest producer in India. It operated the two major mechanized mines in the country—one at Kiriburu and the other at the Bailādila No. 14 deposit—and had three more under development (Donimalai, Bailādila No. 5, and Meghahataburu).

About 53% of the iron ore output was exported in 1976, earning about $280 million or nearly 5% of India's total exports. Japan was the main market, receiving over three-fourths of the ore. Most of the remaining exports went to Romania, Czechoslovakia, the Republic of Korea, the Netherlands, and Turkey.

In previous years, outdated bulk-handling facilities at India's ore-exporting ports caused slow and inefficient loading of bulk ore carriers. To remedy this situation, several of India's ports have been undergoing major modernization of bulk-loading facilities to increase export capability. Marmagao was building new mechanized 8,000-ton-per-hour loading equipment and will be able to berth ships of 60,000 deadweight tons; plans call for an eventual capability to handle 100,000-deadweight-ton ships. Madras can now berth 100,000-deadweight-ton ships and can load over 7 million tons per year. Paradeep is able to handle 2 million tons per year and 55,000-deadweight-ton ships. The $110 million Visākhāpatnam outer harbor development was commissioned in December 1976. The project provided berthing for bulk carriers of 100,000 deadweight tons. The ore-handling facilities have a loading capacity of 8,000 tons per hour with a potential of 16,000 tons per hour.

Supplying these four improved loading facilities could put a strain on the transportation network feeding the ore to the ports, and diligent scheduling and maintenance will be required to prevent bottlenecks or tieups from occurring.

[12] U.S. Embassy, New Delhi, India. State Department Airgram A-70, Apr. 19, 1977, p. 11.

One of the key export-oriented projects during the year was development of the 1-billion-ton Kudremukh magnetite deposit being financed by a $630 million loan from Iran. The project calls for mining low-grade ore (34% to 36% iron), beneficiating it by magnetic separation to 64% to 66% iron, and transporting the concentrate through a 70-kilometer slurry pipeline (the first in India) to the port of Mangalore. There the slurry is to be dried, caked, and shipped to Iran for pellet feedstock. The foreign exchange component of the cost is estimated at $150 million to $170 million for equipment and supplies. The main imported equipment is to include autogenous grinding mills, large shovels, 120- to 150-ton-capacity dump trucks, rotary blasthole drills, crushers, magnetic-separation equipment, concentrators, and slurry pipe and pumps. Construction of the foundation for the concentrator plant began in November 1976; the project was apparently proceeding on schedule with the first shipment of pellet feed due in September 1980.[13]

A new public-sector company, Kudremukh Iron Ore Co. Ltd., was formed in April 1976; Canadian Met-Chem Consultants Ltd. of Montreal, a subsidiary of United States Steel Corporation, was appointed the major contractor for the project. Met-Chem is to design and supervise construction of mine, concentrator, and transport facilities. It will also operate the project for the first 3 years following its completion.

India's fifth 5-year plan (1974–79) provides $123 million for development of iron ore resources by the Government-owned NMDC; it was recognized that cost escalations could push the expenditures to nearly three times the planned amount. Major projects included continued development and expansion of:

(1) The Bailādila No. 5 and No. 14 mines and possibly a 2-million-ton-per-year pelletization plant. Development at the No. 5 mine, originally due for startup in 1974, has cost over $40 million. Serious construction problems at a crucial 2.2-kilometer tunnel at Bailādila No. 5 were overcome during 1976 and construction was resumed. The No. 5 mine will probably begin operating in early summer 1977.

(2) The 4-million-ton-per-year Donimalai mines and a possible pelletization plant near Madras. This plant is to utilize 2.8 million tons per year of fines generated in the production of over 1.2 million tons per year of lump ore. The mine was scheduled for startup by the end of CY1976.[14]

(3) The Kiriburu mine to a capacity of over 1 million tons per year of lump ore and 2.7 million tons per year of fines.

(4) The Meghahataburu mines.

(5) A 1.8-million-ton-per-year pellet plant in Goa by a West German firm.

NMDC also plans to undertake detailed ore drilling and exploratory tunneling at the Chiria deposits in Bihār State and a feasibility study of the banded magnetite-quartzite deposits of the Bababudan Hills of Chikmagalūr District near Kudremukh. Development costs on the latter site were estimated at $500 million.

MEC completed a 2-year exploration of the Manoharpur area in the Bonai ore belt on the Bihār-Orissa border. The deposit reportedly contains the largest ore body in India with reserves of nearly 2 billion tons of 62%-grade iron ore. Unusually high silica and alumina content, however, complicates exploitation of the deposit.

Iron and Steel.—Endowed with abundant iron ore and coal reserves and sizable deposits of manganese, chromite, and limestone, India has developed the steel industry into an important segment of its economy. At the end of the fiscal year, six of the seven integrated steel plants were publicly owned and represented an investment of around $3.25 billion or about 26% of the total investment in the public sector.

Accelerating its steady growth of the past 3 years, the industry had another good year, exceeding its production targets for 1976 and establishing record highs in production, capacity utilization, and exports.

In 1976, total production of pig iron exceeded 10 million tons for the first time, accounting for nearly 1.9% of total world production. India's production of salable steel from the major steel plants rose to 7 million tons, well above the target of 6.6 million tons and more than 21% above the previous year's output. Of particular interest was the encouraging increase in plant capacity utilization at the large integrated mills, which averaged about 66%

[13] Page 90 of work cited in footnote 6.
[14] Work cited in footnote 13.

just 3 years ago but increased to about 92% by 1976.

While the major steel plants were having their best year, the so-called ministeelplants fared rather poorly. Small electric arc furnace plants, with about 4 million tons of total annual capacity, were built during 1973–75 to produce mild steel products. Their establishment represented an effort to relieve the domestic steel shortages that developed at the beginning of the decade; the plants were to use steel scrap previously exported. It was only because of a financial concession and several other incentives granted to them earlier by the Government, and the improvement of the electric power supply, that the minimills were able to slightly increase production to about 1 million tons in 1976.

The policy that had encouraged growth of the ministeelmills in the past was disowned and reversed following the change in the Government administration in March 1977. The new Government appeared unwilling to extend its support or official assistance indiscriminately to the approximately 100 operating mills, many of which were uneconomical, inefficient, and poorly managed. The Government instead was expected to develop a position to give aid selectively to some of the viable mills. The Government was more concerned with the potential loss of employment than with the loss of steel production resulting from mill closures.

Despite increased domestic sales of iron and steel products from 4.7 million tons in 1975 to 5.6 million tons in 1976, the major steel plants continued to hold large inventories of unsold stock, collectively estimated at 1.6 million tons at the end of the fiscal year. To relieve some of the pressure on the producers, the Government was reportedly considering the establishment of a 1-million-ton steel buffer stockpile.

The official targets for the seven major Indian steel producers in 1977 were a 10% increase in production of steel ingot to 9.5 million tons and a rise in salable steel production to 7.5 million tons.

Steel production figures for India occasionally differ from source to source. In table 4, the Government's Iron and Steel Controller production figures were used for consistency.

In 1976, India emerged for the first time as a net exporter of steel as total exports exceeded total imports in both quantity and value. Indian exports for the entire year amounted to 1.4 million tons of steel and 1.0 million tons of pig iron, together valued at about $370 million, the highest value ever recorded for the country. This was nearly triple the quantity and value of exports in 1975. India sold steel to a diverse group of 28 countries in 1976, 14

Table 4.—India: Production of pig iron and steel
(Thousand metric tons)

Year [1]	Pig iron [2]	Steel ingot	Salable steel [3]	Finished steel
1973:				
Total	7,193	6,615	5,460	4,889
Six major mills [4]	NA	5,830	4,350	3,612
1974:				
Total	7,736	7,186	5,678	5,161
Six major mills [4]	NA	6,286	4,800	3,972
1975:				
Total	8,340	7,910	6,179	5,745
Seven major mills [5]	NA	7,390	5,779	4,309
1976: [p]				
Total	10,022	9,731	7,701	6,902
Seven major mills [5]	NA	8,566	7,000	5,490

[p] Preliminary. NA Not available.
[1] Data are for fiscal years beginning Apr. 1 of years stated.
[2] Pig iron figures were not broken down, but nearly all would have come from the major mills.
[3] Salable steel includes not only finished steel but also semifinished primary billets and tin bars, which primary producers sell to secondary producers.
[4] Includes the Bhilai, Visvesvaraya, Durgāpur, and Rourkela steel mills and Indian Iron and Steel Co. in the public sector, and Tata Iron and Steel Co. in the private sector.
[5] Includes those given in footnote 4 plus Bokāro Steel Co. in the public sector, which came into production in 1975.

Source: U.S. Embassy, New Delhi, India. State Department Airgram A–13, Aug. 9, 1977, pp. 1–50.

more than last year and 24 more than in 1973. The principal buyers were Egypt, Dubai, Kuwait, Iran, Japan, the People's Democratic Republic of Yemen, and the U.S.S.R.

Most of the material exported was in the form of relatively low-value pig iron, rods, bars, and billets. In 1977, India is likely to make serious efforts to export more of the higher priced items such as plates, sheets, strips, wire, and galvanized products. These will be available in excess of domestic demand and from new facilities at Bokāro and Rourkela.

India continued to import selected varieties of steel products. Total imports of steel (including scrap) in April through December 1976 fell, however, to about 330,000 tons valued at over $190 million from about 445,000 tons valued at $260 million during the same period in 1975. Two-thirds of the imports came from Japan, West Germany, and the United Kingdom.

India will continue to strive for a steady increase in its steelmaking capacity in order to supply its growing domestic demand and to raise its share in world exports of steel. But the official high priority on the rapid development of the steel industry to a target production of 75 million tons per year by the year 2000 was being revised downward by the new Janata Party Government. The new Government announced that priority will be given to agriculture and rural development, and that preference will be shifted to employment-oriented small and cottage industries from the capital-intensive industries such as steel.

The continuing official programs for the expansion of domestic capacity will not be immediately affected, however, as funding was already committed for some new projects. Plans called for the expansion of the Bokāro Steel Co. plant from 1.7 million tons to 4.0 million tons per year by March 1980 and of the Bhilai plant from 2.5 million tons to 4.0 million tons per year by December 1981, and modernization of the old Indian Iron and Steel Co. plant at Burnpur as well as doubling of capacity to 2.0 million tons per year.

The Government approved the construction of the Salem steel plant in Tamil Nadu, to be done in two phases. The first phase, estimated to cost $150 million with a capacity of 32,000 tons per year of cold-rolled stainless steel sheet, was planned for completion by June 1981. The second phase, estimated to cost an additional $490 million, envisioned the installation of hot-rolling facilities and the expansion of the plant to 220,000 tons per year. The plant would produce stainless steel sheets, strips, and other specialty steels formerly imported.[15]

The continually increasing cost estimates and the shortage of investment funds had discouraged the Government from making firm commitments for construction of the proposed 3-million-ton-per-year steel plants at Visākhāpatnam and Vijayanagar. The new Government will probably look even more critically at these two projects.

India was planning to establish a 30,000-ton-per-year sponge iron pilot plant at Kottagudem in Andhra Pradesh and a commercial-size 200,000-ton-per-year plant in Bihār. At yearend 1976, the Ministry of Steel and Mines was evaluating two different processes for the plants. A decision on the process to be used and the arrangements for funding the projects were expected to be completed by mid-1977.

Lead and Zinc.—Hindustan Zinc Limited (HZL), the Government-owned lead and zinc company, had a particularly noteworthy year with the commissioning of three new or expanded smelters. In January 1977, a major $30 million expansion program was completed at the Debari zinc smelter near Udaipur in Rājasthān. Zinc capacity was increased from 18,000 tons to 45,000 tons per year. The major features of the expansion were installation of a new roaster by a West German firm and construction of a byproduct phosphoric acid plant.[16]

Construction of a new 30,000-ton-per-year zinc smelter, based on 60,000 tons per year of imported zinc concentrate, was completed in February 1977 at Visākhāpatnam in Andhra Pradesh. The plant will also produce about 200 tons per day of byproduct sulfuric acid. Cost of the project was reported at $51 million, about double the originally planned outlay. The new smelter may have economic problems in its first year of operations. When the plant was approved in 1970, there was no import duty on zinc concentrate, in contrast to a stiff

[15] Work cited in footnote 13.
[16] Work cited in footnote 13.

duty of 45% ad valorem in 1976. The originally planned cost of water has skyrocketed, and the availability of electric power, originally thought to be good, was critically low at yearend.

A 10,000-ton-per-year lead smelter was under construction at Visākhāpatnam and is to be commissioned in 1977.

The HZL lead smelter at Tundoo in Bihār was modernized and the principal sections completed during 1976. Capacity was increased from 5,400 tons to 8,000 tons per year. It was the only lead smelter in India.

Total zinc capacity at yearend was 95,000 tons per year, inasmuch as the capacity of the privately owned Cominco-Binani Zinc Ltd. smelter at Alwaye in Kerala was unchanged at 20,000 tons per year.

In order to meet some of the additional needs of the Debari smelter, a new 2,000-ton-per-day mine was being developed at Balaria in the Zawar area near Udaipur. Supporting ore beneficiation facilities were also being built. The existing Balaria mine produced 800 tons per day of lead-zinc ore. It was unclear whether the new mine was to replace the old one or be in addition to the old production. Cost of the project was over $23 million.

Development by HZL of the Rajpura-Dariba deposits, also near Udaipur, was continuing. The 550-meter-deep shaft was under construction. The mine and associated concentrator will handle 3,000 tons of ore per day. Output will help feed the expanded Debari zinc smelter. The $50 million project was scheduled for completion in 1981.

A feasibility report on development of the lead deposits at Sargipalli in Orissa showed that the project was not viable in the proposed form. HZL was carrying out additional exploration work and is to try to develop a new plan.

A lead concentrator reportedly began production during 1976 at Bandalamottu in Guntur District. A part of the development of the Agnigundala lead-copper deposit in Andhra Pradesh, the plant had a capacity of 120 tons of ore per day, and plans call for doubling this capacity. The concentrate assayed about 65% lead content. Metal content of the ore was 6%, but only about 10 years of reserves were proved.

Total production of ore by HZL for CY1976 was 835,000 tons. About 45,000 tons of zinc concentrate was produced with a value of $9.2 million. Zinc metal production was up marginally, from 25,700 tons in CY1975 to 26,800 tons in CY1976. Lead metal output reached 5,435 tons in CY1976, a 14% increase over that of CY1975. Zinc imports were 49,107 tons and those for lead were 46,379 tons.

Manganese.—Manganese is one of India's most important minerals and has been a significant source of foreign exchange for many years. In an effort to conserve resources, the Government banned export of all high-grade ore and put export ceilings on the medium- and low-grade material. There was a small decline in the tonnage of ore exported in CY1976, and the value of exports declined from $19 million in 1975 to $18 million in 1976. Export quotas will probably be set at about 900,000 tons of medium- and low-grade ore in 1977 to take advantage of the increased demand for exports and higher prices.

Manganese ore production in CY1976 rose about 12% to nearly 1.8 million tons. The main producer, Manganese Ore India Ltd. (MOIL), a Government-run company in Nagpur, operated eight mines which generally account for 20% to 25% of India's total production. The Government planned to buy out the privately owned 49% of the joint-sector company. MOIL would thus become a totally Government-owned operation. Most of MOIL's output was high-grade ore and was sold to ferromanganese plants.

Over 60% of India's manganese production comes from open pit mines in Orissa and Karnataka. At the beginning of 1976, there were 332 mines in India, of which 182 mines actually reported production.

Manganese reserves were officially put at 108 million tons, including the 7.7 million tons proved in 1976. However, GSI, in conjunction with MEC, continued to explore for new deposits, reportedly with considerable success.

Work on a new 1,000-ton-per-year battery-grade electrolytic manganese dioxide plant at Trivandrum in Kerala State continued toward a mid-1977 startup date. The plant is unusual because it will utilize waste sulfate and acid solutions from a nearby titanium plant in place of the ex-

pensive commercial acid. Plans were being completed for a 45,000-ton-per-year ferromanganese and silicomanganese plant at Tumsar in the Bhandāra District of Maharashtra.

NONMETALS

India's nonmetallic mineral production was valued at $122 million in CY1976 (nearly the same as in CY1975), or 8% of the country's total mineral output value. Two minerals, limestone and phosphate rock, accounted for nearly three-fourths of the total value in the nonmetals sector.

Barite.—Barite reserves were estimated at over 8 million tons, among the largest in the world. They were located mostly in Andhra Pradesh. In view of the increasing world demand for barite, GSI intensified its search for new deposits. It had reportedly located the world's largest deposit, at least 15 million tons, at Mangampeta in the Cuddapah District of Andhra Pradesh. Detailed drilling of the deposit was continuing, and the reserves will probably be much higher than the reported amount. The State-owned Andhra Pradesh Mining Corp. planned to mine the deposit and build a plant at Cuddapah to process the ore both for export and for domestic consumption. India's major consumer was the Oil and Natural Gas Commission (ONGC).

Barite production increased steadily during the last 4 years, reaching about 235,000 tons in 1976, making India eighth in world output. This represented a 32% increase in value over that of 1975 and roughly a fivefold increase since 1972.

Exports were over 151,000 tons valued at $8.8 million in CY1976. The export target for 1977 was placed at 300,000 tons with a projected value of $14 million.

Cement and Limestone.—Limestone accounted for about 45% of the total value of nonmetallic mineral production in 1976. Production increased nearly 11% to more than 29 million tons. The cement and steel industries used about 90% of the output. Limestone production was expected to continue a steady increase in light of expected steel and cement industry capacity increases. Reserves, estimated at 50 billion tons, are adequate to meet long-term needs. About 28 billion tons of the reserves were considered to be of cement grade, most of which were in the Gulbarga District of Karnataka and the Kurnool and Cuddapah Districts of Andhra Pradesh.

Portland cement capacity remained essentially unchanged at about 21 million tons per year at 54 plants, 9 in the public sector and 45 privately owned. Output increased to 18.6 million tons and capacity utilization increased from 77% to 88%. The Government-owned cement plants were reportedly going to begin production of a special oil well cement. The sulfate-resistant cement was formerly imported.

Orders have been placed for equipment for a new two-kiln plant with cyclone preheaters and grate coolers at Maihar in Madhya Pradesh. Capacity of the two kilns is to total 2,400 tons per day. The Nimbahera plant in Rājastān was being expanded with the addition of a 1,200-ton-per-day kiln, cyclone preheater, planetary cooler, and grinding mills.

Diamond.—India's production of diamond remained stable at about 20,000 carats. Production was entirely from the Government-owned Panna diamond mines in Madhya Pradesh. Value of the domestic output at the mine was estimated at $1.1 million.

Exploration by GSI in Andhra Pradesh revealed diamond-bearing kimberlitic works at Vajrakarūr, Raman Katla, Baganpalli, and Anantapur. Further assessment work was in progress.

Despite the small indigenous production, India's exports of diamond constituted 34% of the value of nonmetallic minerals exported. The trade was dependent on the import of uncut diamond which was cut and polished by local artisans and then reexported as finished stones and jewelry. The Indian diamond-cutting and polishing industry, which employed about 5,000 persons 15 years ago, had about 150,000 skilled and unskilled workers at yearend. Exports in CY1976 reportedly totaled $220 million, a sixfold increase over those of 1971. The value of uncut diamond imports reportedly rose from $79 million in CY1975 to $159 million in CY1976. The major supplier was the Diamond Trading Company of London, with small amounts coming from the Ivory Coast, Zaire, and Belgium.

Fertilizer Materials.—Total plant nutrient consumption (nitrogen, phosphorus, and potassium) in 1976 reportedly increased about 18% to 3.4 million tons. Ni-

trogen consumption rose 14% (to nearly 2.5 million tons of contained nitrogen), phosphate 36%, and potash 14%. The current growth in consumption was stimulated by the Government's drive for increased agricultural output (especially of high-yield cereal crops), expanded use of irrigation, and increased use of multiple cropping. Consumption in recent years had been less than the agricultural conditions warranted because of high prices and tight credit restrictions on farmers' borrowing. The trend appeared to have been reversed in 1976, with prices being lowered and consumption and domestic production likely to increase markedly in the coming years. Considerable capacity expansion was underway or in the advanced planning stage. This expansion reflected the Government's growing reluctance to depend on imports for India's critical fertilizer requirements.[17]

The plants under construction or in the final planning stages would expand annual ammonia capacity in India by nearly 2.8 million tons nitrogen, urea capacity by 2.2 million tons nitrogen, and complex fertilizer capacity by 0.5 million tons nitrogen. The nitrogen expansion would represent a near doubling of capacity between 1975 and 1980 if all plants are completed on schedule. Two new projects rescheduled for a 1978 startup date are to use coal as the raw material and source of energy. They are the 244,000-ton-per-year ammonia/228,000-ton-per-year urea plants at Talcher and Ramagundam. Technical problems reported at yearend could cause further delay in the startup of these plants. Future plants, however, will almost certainly be based on natural gas which is to be available from the offshore Bombay High and Bassein Fields.[18]

Phosphate rock production in CY1976 reached a record high of 644,119 tons, representing a 50% increase over production in CY1975. Projected minehead value was estimated at $20 million. Production was confined to the States of Rājasthān, Uttar Pradesh, and Madhya Pradesh. India's most important mine was located at Jhamar Kotra (24°28′ N, 73°52′ E), near Udaipur. Proved reserves at the Jhamar Kotra mine were placed at over 43 million tons of ore with over 18% P_2O_5, more than half of the proved reserves in India. Exploration was continuing to determine the full extent of the deposit. Production reached 500,000 tons and was targeted for 700,000 tons in 1977. Only direct-shipping, 33% to 35% P_2O_5 ore was being mined at Jhamar Kotra for use in manufacturing chemical fertilizers. Two foreign firms were reportedly testing the low-grade ore with the intention of setting up a processing plant. The plant would handle 1.5 million to 2.0 million tons of ore annually and turn out 750,000 to 1,000,000 tons of concentrate. There was only one beneficiation plant operating in India in 1976. It was located at Maton near Udaipur and produced about 28,000 tons of 34% P_2O_5 concentrate from 110,000 tons of ore. Work is now proceeding on doubling the present 300-ton-per-day capacity of the plant. The concentrate was used as feedstock for the single superphosphate plant located nearby at Debari where a 29,000-ton-per-year phosphoric acid plant was scheduled to open in 1978.

Phosphate rock imports amounted to 471,528 tons in CY1976. The United States, Morocco, Jordan, and Senegal were the only suppliers.

As of October 1976, installed capacity for production of phosphatic fertilizer stood at 927,000 tons per year. Existing plants operated at about one-half of their rated capacity of 478,000 tons of P_2O_5 content during 1976, up from 320,000 tons in 1975.

Mica.—Mica is one of India's traditional mineral exports. However, both production and exports declined in CY1976—production, 28% to about 32,147 tons and exports, 36% to just over 22,000 tons. There were 214 mines reporting production in December 1976, 65 fewer than in August 1975. Production was mainly from Bihār, Andhra Pradesh, and Rājasthān. The Indian Bureau of Mines recently located two new minable mica pegmatites in the Nellore District of Andhra Pradesh.

Although the tonnage of mica exports declined in 1976, the value rose about $6 million as a result of world price increases. Crude mica exports were valued at $19 million and fabricated mica exports at $8 million. According to trade sources, the U.S.S.R. and Eastern European countries were the major importers of Indian mica. Export prospects looked promising for 1977

[17] Page 48 of work cited in footnote 6.
[18] Ministry of Petroleum, Chemicals, and Fertilizers (New Delhi). Report 1976–77, pp. 1–48.

because of recent interest shown by Japan and the Republic of Korea in Indian mica.

The Government was trying to increase the amount of fabricated mica exported in view of the much higher unit value and market potential. East Germany was preparing a feasibility study on setting up a fabricated mica plant in India, estimated to cost $7 million. Negotiations were also underway with Norwegian and U.S. firms for equipment and technology to manufacture different grades of mica powder.

Because of the small reserve and the erratic nature of mica-bearing pegmatites, there has never been a systematic approach to the mining of India's mica, so it remains basically a cottage industry.

MINERAL FUELS

Coal.—Coal remained the principal source of Indian energy, despite growing competition from oil. Coal met approximately 70% of the total commercial energy needs of the country. Petroleum contributed 20% and hydroelectric and nuclear energy supplied the remainder.

Coal India Limited (CIL), the Government-owned holding company for the coal industry, employed over 600,000 persons, roughly 80% of the total mineral industry labor force. The company had made a large capital investment in maintenance, modernization, and mine safety and had been operating at a loss since its founding in November 1975. Wages, which comprised nearly two-thirds of the cost of production, had more than tripled in 2 years, contributing to the lack of profits. The Government-controlled selling price of the coal in some of CIL's subsidiaries was bringing considerably less than the pithead production cost. The Government, however, was hesitant to allow major price increases because of the strong effect this would have on the wide range of industries dependent on coal.

Bituminous.—According to the Ministry of Energy, bituminous coal reserves were estimated at 20.7 billion tons proved, 32.0 billion tons indicated, and 30.8 billion tons inferred, for a total of 83.5 billion tons. Coking coal accounts for about 23% of this total. Over two-thirds of the reserves were located in the three adjacent eastern States of Bihār, West Bengal, and Orissa. The imbalance of distribution causes transport problems for southern and western Indian consumers who must absorb freight charges for coal deliveries from mines often more than 1,000 kilometers away.

GSI recently discovered large reserves of bituminous coal suitable for power generation in the Rājmahāl hills of Bihār. Reportedly, 440 million tons has so far been estimated in the Hura coalfield, of which about 150 million tons will be suitable for power stations. Also, in the nearby Chuparbhita coalfield, 982 million tons of similar-quality bituminous coal has been estimated to a depth of 500 meters. These deposits would feed the proposed huge Farakka thermal power station.

The Government's major focus continued to be on metallurgical-grade coal confined primarily to the Jharia, Raniganj, and Western Bokāro coalfields. Coking coal deposits of 152 million tons were reported in the Bhowra block and 33 million tons in the Mohuda block of the Jharia coalfield. Based on these discoveries, coking coal reserve estimates were revised upward to just over 20 billion tons at yearend 1976.

Coal exploration continued to be very active during the year. Exploration drilling amounted to about 146,000 meters in 1976. The 1977 target called for nearly 200,000 meters. About 165 drills were deployed by the coal companies and an additional 60 drills were engaged by GSI.

India's bituminous coal production, again a record high in CY1976, was up more than 5% to 101 million tons, with coking coal representing about 29% of the total. The value of the output was placed at $826 million. In 1976, open pit mines accounted for about 25% of the total output, but that was expected to increase to 33% by 1983. The change will result from the increased efficiency and productivity of newly mechanized open pit mines. The steady growth of India's bituminous coal production is shown below, in million tons and million dollars:

Year	Quantity	Value
1972	74.8	305
1973	77.9	314
1974	84.1	473
1975	95.9	606
1976	101.0	826

As a result of slowdown in industrial demand, pithead stocks reached a record high of 14.5 million tons at yearend. The output for 1977 was expected to remain at

about the 1976 level. Because of the large stocks and lowered demand, the target for 1978 was revised downward to a 108-million- to 110-million-ton level from the earlier projection of 124 million tons.

Coal mining in India remains a highly labor-intensive industry, with output per man-shift being one of the lowest in the world. Plans were under consideration for the application of technology to improve the recovery and beneficiation of coal. One of the basic complaints of end users continued to be the lack of quality control. This, combined with a rising ash content, has caused consumers to express strong concerns about the calorific value of the coal being supplied and its adverse effect on equipment and industrial production, particularly that of steel. India's steel plants were receiving coal with an ash content of up to 22%, compared with foreign steel plants which operate on 5% to 9% ash. To improve quality control, plans called for increasing the number of washeries for coking coal from 14 to 26 by 1985. This would increase the existing washery capacity by 18 million tons to roughly 44 million tons per year. Present washeries were operating at about 80% capacity. There were currently plans for the construction of four new washeries totaling 10 million tons per year capacity. They were to be located at Sudamdih and Monidih (2 million tons each) and at Ramgarh and Kedla-Pundi (3 million tons each).

Bituminous coal consumption in 1976 was 99.2 million tons, up about 4% over that of 1975. Public-sector industries such as railroads, steel plants, and thermal powerplants continued to be the main consumers, accounting for over 60% of the total demand. The changing consumption pattern in recent years is shown in the following tabulation, in million tons:

	1973	1974	1975	1976	1978 [1]
Thermal powerplants	17.0	[r] 19.6	[r] 24.0	25.0	[r] 31.6
Steel plants	13.7	[r] 15.4	[r] 19.0	20.0	[r] 24.5
Railroads	13.9	14.4	[r] 14.4	14.0	13.5
Cement plants	3.6	4.4	[r] 4.5	4.9	5.1
Brick kilns	2.3	2.5	[r] 3.0	3.5	4.5
Soft coke	3.9	3.7	3.7	3.8	3.8
Other	23.4	27.5	26.8	28.0	27.0
Total	77.8	87.5	95.4	99.2	110.0

[r] Revised.
[1] Projected.

Bituminous coal consumption in 1977 was expected to be up marginally to about 101 million tons, reflecting the slowdown in industrial growth. By 1983, demand could be as high as 155 million tons. However, that consumption level would be dependent on the success of the power sector in carrying out its projected major expansion program. Bituminous coal consumption by the railroads was expected to remain stable or perhaps decline a little as more lines are electrified and more efficient diesel locomotives are used.

Despite expectations of exceeding 1.0 million tons in 1976, exports during the year reached only 622,000 tons, up only marginally from those of 1975. The major importers of Indian bituminous coal were Bangladesh (268,000 tons), Burma (106,000 tons), and Taiwan (78,000 tons). Belgium imported the first shipment of Indian coal to a European country in June 1976. Belgium, the Netherlands, France, and Denmark received a combined total of 134,000 tons during the year. Poor coal-handling facilities at Haldia and Paradeep as well as draught limitations at Haldia continued to impose the major constraints on exports. Improvements in these facilities were progressing slowly, so exports in 1977 are not likely to exceed 1 million tons, compared with the original target of 2 million tons. There was talk about importing low-ash coal from Australia to blend with domestic bituminous coal. The Ministry of Steel reportedly favored the move to improve the operating efficiency of its steel plants. The much higher cost of imported coal and the lack of bulk coal-unloading facilities will be major factors in the pending Government decision on the matter.

CIL was working on 71 projects at an estimated cost of $814 million. The projects, in various stages of implementation, were designed to increase the country's production capacity by 67 million tons in the next 6 to 8 years. The major projects included development of 42 underground

and 24 open pit coal mines, primarily through consolidation and modernization; expanding the washery capacity for coking coal; and establishment of gasification, coke oven, and low-temperature carbonization plants. Proposals for beneficiation of non-coking coal were also being considered.

In light of the 20% to 30% ash content of most Indian bituminous coal, a recent development could, if commercially and technically successful, be extremely helpful for the Indian coal industry. India's Central Fuel Research Institute reportedly developed a new oil agglomeration technique that would reduce the mineral content of coal from 25% to 4%. Recovery of combustible carbon was 90%, compared with 50% by prevailing methods. A 2-ton-per-hour pilot plant was being constructed at the Jharia coalfields to test the new process.

The U.S.S.R. was aiding in the design of what is to be India's largest bituminous coal mine. The Jayant mine in the Singrauli area of Madhya Pradesh will exploit reserves at the coalfield estimated at over 7.5 billion tons. Design work was expected to be completed in March 1978. The use of large, high-capacity draglines, dump trucks, and drills will permit a capacity of 10 million tons per year when fully developed. The output of the mine will support the 2,000-megawatt Mirzāpur District super thermal powerplant a few kilometers across the border in Uttar Pradesh. Long-term plans called for the further development of the Singrauli field by designing additional open pit mines, leading to an eventual production of 45 million tons per year at the turn of the century.

In addition to the 2-million-ton-per-year coal-washing plants planned or under construction at Sudamdih and Monidih, CIL was planning to begin a major mechanization program at the Monidih No. 1 mine near Dhanbad in Bihār. The new system would greatly increase the productivity of the mine.

The overall planned increases in production are certainly attainable with the coal reserves already indicated. However, investment capital for the Government-run coal industry may be difficult to acquire in the amounts needed during the next few years. In addition, the Indian economy may not be able to absorb the large production increases in the planned time frame. Therefore, the planned 67-million-ton-per-year capacity increase may more realistically be reached in a decade or more.

Lignite.—India's lignite reserves were estimated at 2.1 billion tons, 1.9 billion of which were located at Neyveli in the southern Indian State of Tamil Nadu. Most of the remaining 200 million tons was located in Gujarāt State in western India. The Government-owned Neyveli Lignite Corp. (NLC) mines the lignite mainly for use in a 600-megawatt thermal powerplant, a chemical fertilizer plant, and a briquetting plant.

Lignite production totaled 3.9 million tons in CY1976, up 38% over that of the previous year. NLC claimed that the production increase was owing to improved labor relations and to an increase in the production incentive bonus. Plans called for stepping up the production capacity to 6.5 million tons per year by 1980. Orders for necessary equipment were reportedly placed with domestic and foreign suppliers, and over $100 million was approved for the new equipment.

The lignite stockpile was at 684,000 tons at yearend, more than doubling the 1975 stocks. The more favorable stock level would allow a higher assured power output for electric-power-deficient Tamil Nadu State.

Petroleum and Natural Gas.—The main focus of the ONGC's activities continued to be offshore exploration and development, primarily at the Bombay High Field. This was the first offshore petroleum discovery in India, and commercial production from this field began in May 1976 from two wells on platform A at an initial rate of 4,300 barrels per day. By yearend, production had reached 16,000 barrels per day. Plans called for bringing platform D into production by mid-1977, bringing total production to about 35,000 barrels per day from the two platforms.

Oil was discovered on the Bassein North structure and natural gas on the Bassein South structure, both located southeast of the Bombay High Field. Additional exploration included drilling wells on four nearby potential oil structures.

Production wells were to be drilled by the jackup rig *Shenandoah* for platforms C and E during 1977 and for platform B in

early 1978. Completion of this drilling would conclude phase two development. Production at that time should be at the planned 80,000-barrel-per-day level, equivalent to 4 million tons per year.

Phase three is to commence by October 1977 with the laying of a 220-kilometer-long, 76-centimeter-diameter (30-inch) subsea crude oil pipeline and a parallel 66-centimeter-diameter (26-inch) subsea gas pipeline to onshore terminal facilities at Uran near Bombay. The oil pipeline is to bring crude oil production to 120,000 barrels per day by May 1979. Onshore, the oil line will connect to two refineries and the gas line will connect to a fertilizer plant at Trombay. Phase three also includes construction of platform F with gas-treatment and oil-pumping facilities, five more platforms at the Bombay High Field, and one or two well platforms, a process platform, and a flare jacket for the Bassein North Field, also to be served by the pipelines.

Phases four and five provide for raising the crude oil production rate to 200,000 barrels per day and producing 3 million to 4 million cubic meters per day of associated gas by 1981.

The cost of development at the Bombay High Field will be about $183 million upon completion of phase two and is expected to exceed $1 billion with the completion of phase five work. The 200,000 barrels per day of additional petroleum production would replace about $1 billion per year of imported oil at current prices.

ONGC may take up seismic work as a prelude to exploratory drilling in the Kutch Basin (relinquished by Reading & Bates Offshore Drilling Co. (United States) after drilling one dry well), and in the Bay of Bengal (abandoned by Natomas/Carlsberg (United States) following the drilling of two dry wells). At yearend 1976, the Government was still receptive to exploration offers from foreign companies on these or other open blocks on a production-sharing or contract drilling basis.

Asamera Oil Corp. Ltd. (Canada), in which ONGC has a 35% share, completed seismic work in the Gulf of Mannar off the Tamil Nadu coast, and began analyzing the data in November 1976. The results were favorable, and a drilling rig was chartered and the first well was to be spudded in March 1977.

ONGC's 1976 onshore activities were largely confined to exploration in Gujarāt and Assam in order to establish additional reserves in proven areas. Plans for 1977 called for stepping up exploration in the eastern region to double the crude oil output from 1.2 million tons in 1976 to 2.5 million tons in 1978.

ONGC operated in three overseas areas during 1976—Iran, Iraq, and Tanzania. In Iran, an ONGC subsidiary has a one-sixth interest in the operation of the Rostam oilfield. During 1976, its share was 3.4 million barrels. In Iraq, ONGC's activities were confined to contract seismic work during the year. In late 1975, ONGC had completed drilling one contract well in the Abu Keme area. It struck a flow of oil which in India or the United States would have been developed but was considered uneconomical in Iraq, so the well was abandoned. ONGC drilled a contract well on Songo Songo Island for the Tanzanian Government in 1976. The well struck gas, then blew out destroying the rig and the well. Another rig was brought in and drilled a second well, reportedly finding a gasfield with a massive 30-billion-cubic-meter reserve.

Oil India Limited (OIL), a joint-sector company owned 50% by the Government of India and 50% by Burmah Oil Co. Ltd. of the United Kingdom, continued to operate two small concessions in northeastern India. The company produced a little over 3 million tons of oil during 1976. It drilled 12 wells in 1976 and planned to drill 14 wells in 1977. Negotiations were taking place for the Government's acquisition of Burmah Oil's share of the company. When this is completed, OIL plans to expand exploration to the eastcoast offshore areas as well.

India's crude oil production was up slightly in CY1976 to 8.66 million tons. ONGC's increase was from the Bombay High Field's new production; OIL's output from the Assam oilfields remained steady. The private-sector Assam Oil Co., Ltd., contributed only 63,000 tons as production continued to decline. India's crude oil production target for 1977 was set at 11.25 million tons, and a 14.23-million-ton output was planned for 1978 although this may be somewhat optimistic. Assuming that the Bombay High development is completed on schedule with production of 10 million

tons per year in 1981 and that the North Bassein Field will add another 2 million tons per year, total Indian production should reach around 22 million tons in 1981. Unfortunately for the Indian energy situation, it is estimated that the demand for oil will have risen to about 32 million to 34 million tons by that time. Since the shortfall will have to be made up by imports, the goal of self-sufficiency by the mid-1980's appears unrealistic.

Usable natural gas production in 1976 was reported at 1.97 billion cubic meters, up about 4% over that of the previous year. Much of the gross production was flared and will continue to be flared until adequate pipelines and gas-based industries are developed. With the planned completion of the Bombay High gas pipeline in 1978, the volume of gas produced will increase substantially, peaking at 3 million to 4 million cubic meters per day in 1981. Substantial amounts of gas are also expected from the South Bassein structure when this field comes onstream in several years. Utilization of this gas was under study by a number of industries including fertilizer, petrochemical, and electric power in the States of Maharashtra and Gujarāt.

Despite the continual growth of the domestic petroleum industry, India still required large imports of both crude oil and refined products because demand rose almost as fast as the exploration program discovered new supplies. Iran, Saudi Arabia, and Iraq were the major crude oil suppliers, and the U.S.S.R. and Kuwait furnished most of the refined products. The cost of petroleum imports reached a new record high of $1.56 billion during CY1976—$1.30 billion for 14.0 million tons of crude oil and $259 million for 2.3 million tons of refined products.[19]

Crude oil imports were projected to increase slightly in 1977 to about 14.5 million tons. Most contracts were on a government-to-government basis. The U.S.S.R., the traditional products supplier, agreed to furnish 1 million tons of crude oil in 1977 and 1.5 million tons per year for the following 3 years.

India exports a few surplus products to neighboring countries, dropping in value from $14 million in 1975 to $9 million in 1976. Exports were not likely to increase in the coming years because of the rising domestic demand.

As demand for petroleum products increases, Indian planners continue to make every effort possible to decrease India's dependence on foreign oil, particularly on expensive petroleum products. According to the fifth 5-year plan, the country's refinery capacity is to be increased to 37.8 million tons per year by 1980. This is to be accomplished by the expansion of two existing refineries and the construction of two new ones. India's annual refinery capacity for 1976 and that projected for 1980 and crude oil throughput in CY1974–76 were as follows, in million tons:

[19] Ministry of Petroleum, Chemicals, and Fertilizers (New Delhi). Report 1977–78, pp. 1–45.

Company and refinery	Location	Design capacity [1]		Crude oil throughput [2]		
		1976	1980	1974	1975	1976
GOVERNMENT OWNERSHIP						
Indian Oil Corporation Ltd.:						
Barauni	Bihār	3.00	3.40	2.817	2.898	2.835
Gauhāti	Assam	.80	.80	.752	.802	.823
Haldia	West Bengal	2.50	2.50	--	1.125	1.825
Koyali (or Baroda)	Gujarāt	4.30	7.30	3.715	4.036	4.123
Mathura [3]	Uttar Pradesh	--	6.00	--	--	--
Hindustan Petroleum Corp. Ltd.: Hindustan (formerly Esso)	Maharashtra	3.50	3.50	3.153	2.722	2.820
Bharat Refineries Ltd.: Bharat (formerly Burmah-Shell)	----do	5.25	5.25	3.988	3.528	3.750
Caltex Oil Refining (India) Ltd.: Caltex (or Visākhāpatnam)	Andhra Pradesh	1.55	1.55	1.155	1.052	1.069
Bongaigaon Refinery and Petrochemical Corp. Ltd.: Bongaigaon [3]	Assam	--	1.00	--	--	--
JOINT GOVERNMENT-PRIVATE OWNERSHIP						
Cochin Refineries Ltd.: Cochin	Kerala	3.30	3.30	2.345	2.442	2.384
Madras Refineries Ltd.: Madras	Tamil Nadu	2.65	2.65	2.325	2.697	2.603
PRIVATE OWNERSHIP						
Assam Oil Co. Ltd.: Digboi (or Assam)	Assam	.50	.50	.533	.533	.530
Total		27.35	37.75	20.783	21.835	22.762

[1] Data are for years beginning Apr. 1 of years stated.
[2] Data are for calendar years.
[3] Under construction.

Source: Oil Statistics. V. XV, No. 1, January–March 1977, p. 12.

Construction on the large Mathura refinery, 130 kilometers south of New Delhi, continued during the year with both U.S. and Soviet technical assistance. Completion was scheduled for 1980. Completion of the 1-million-ton-per-year Bongaigaon refinery in Assam fell behind schedule, mainly becreased 6% to 23.6 million tons in CY1976. original plans. The delays caused the original $148 million cost to balloon to $239 million, and further increases could be expected. Originally planned for operation in 1977, startup is now expected to be well into 1978 if there are no new delays.

Consumption of petroleum products increased 6% to 23.6 million tons in CY1976. Significant increases were recorded for naphtha and light diesel oil because of rising demand by fertilizer plants and the general pickup in industrial demand. Consumption of furnace oil was stable because of the earlier switch to use of coal by many powerplants. Efforts were underway to convert more industries from furnace oil to coal as their main fuel. Demand for 1977 was estimated at 25.0 million tons (a 6% increase). Assuming that consumption continues to increase at the present rate, demand should be over 32 million tons in 1981.

In addition to the phase three Bombay High offshore pipelines, there was one major onshore pipeline under construction in 1976, the 1,222-kilometer Salaya-Koyali-Mathura pipeline. It is designed to transport imported crude oil from the Salaya offshore terminal in the Bay of Cambay to the Koyali and Mathura refineries. The originally projected cost of the pipeline was $214 million, but costs were expected to escalate well above that figure. Installation of the offshore single-buoy mooring point at Salaya was underway, and the 120-kilometer section between Viramgrām and Koyali was completed. Construction of the pipeline from Salaya to Viramgrām had also started. Operation of the pipeline to the Koyali refinery should begin by January 1978 and to the Mathura refinery by June 1979. A pipeline was proposed from Mathura to Ambāla in order to distribute petroleum products to Haryana and Punjab. Construction was to begin in 1980.

The Mineral Industry of Indonesia

By K. P. Wang [1]

A new air of relaxation and self-confidence was evident among Indonesia's economic planners at the end of the fiscal year from April 1976 to March 1977.[2] The crisis of the State oil company P.T. Pertamina and its foreign borrowings had been overcome, and the country was ready to return to normalcy and resume growth in line with the targets of Repelita II (the second 5-year plan, covering 1974–79).

Petroleum production was up, and there were signs of increased interest in exploration. The oil contract renegotiations were essentially concluded, and Indonesia went out of its way to take a pragmatic view of the needs and feelings of foreign investors. Foreign exchange reserves soared to $2.4 billion[3] at the end of July 1977, a $1 billion increase over those of the year before. Net petroleum earnings of $3.7 billion in fiscal year 1976–77 accounted for 59% of the country's net foreign exchange earnings, and tax revenues from petroleum activities of $4 billion accounted for 59% of total budget receipts. Nonoil exports of $3.5 billion in fiscal year 1976–77 were one-third higher than those of the year before.

Indonesia's gross national product (GNP), in constant 1973 prices, increased from approximately $18.4 billion in 1975 ($29.2 billion in current prices) to about $19.8 billion in 1976. However, the inflation rate remained high, with the cost of living increasing about 14% in 1976. Oil output value increased from about $7 billion in 1975 to $8 billion in 1976 at current prices. The country's potentially very important natural gas industry was still in the development stage, with most of the gas being flared. However, various large liquefied natural gas (LNG) and nitrogenous fertilizer facilities were being built. In 1976, the value of mineral and metal production except oil totaled less than $500 million, headed by tin, cement, copper, fertilizers, nickel, and bauxite. Fuels and minerals together contributed about 25% of the GNP, indicating the raw material nature of Indonesia's economy. Petroleum dominated exports, accounting for more than 70% of all 1976 exports. Agriculture contributed approximately one-third of the GNP, but only about one-fourth of all exports.

At yearend 1976, the Minister of Mines, Mohammed Sadli, stated, "Despite its vulnerability and shortcomings, the Indonesian mining sector has very good prospects. They depend upon several factors: The development of national politics, the international economic situation, and technological developments. These factors together place the mining sector in a special position."

The Indonesian Government made considerable progress in managing the Pertamina debt in 1976. Local currency obligations were substantially reduced and 12 tanker contracts were resolved, with additional settlements a distinct possibility. Pertamina continued to streamline operations in an effort to concentrate more exclusively on oil-related activities. Several changes in the Pertamina board of directors were announced.

The formation of the Technical Committee of Energy Power-Resources on November 11, 1976, marked the first step

[1] Supervisory physical scientist, International Data and Analysis.

[2] Far East Economic Review (Hong Kong). Indonesia: Back to the Real Priorities. Sept. 9, 1977, pp. 49–56.

[3] Where necessary, values have been converted from Indonesian rupiahs (Rp) to U.S. dollars at the rate of Rp415 = US$1.00.

toward a comprehensive energy policy that will respond to the new realities of coming decades. The new plan is expected to lay stress on the twin goals of continued expansion of oil reserves for export and the rapid development of nonoil energy resources, particularly coal, to meet the anticipated growth in domestic energy consumption.

The oil and gas industry made notable gains, with many new lesser producers coming into full production to complement P.T. Caltex Pacific Indonesia, the dominant producer. Two significant LNG projects, together costing close to $2 billion, were well into the first phase which should be completed in 1977; one is Mobil Oil Indonesia Inc.'s Arun Field in North Sumatra and the other is Roy M. Huffington, Inc.'s (Huffco) Badak Field in East Kalimantan. Based on natural gas, Indonesia's fertilizer industry was expected to more than double capacity between 1976 and 1978. Petrochemicals got off the ground floor, and construction of new refining facilities to meet future domestic demand was being planned.

The tin industry showed a small decline in mine production, despite good tin prices, as it geared for expanded output, with two large dredges ordered for delivery in the near future. Smelter tin production rose sharply, as a result of more normal utilization of the new reverberatory furnaces. Initial work on the very important Asahan aluminum and power project got underway. The first large nickel plant, located at Soroako on Sulawesi and owned mainly by P.T. International Nickel Indonesia (P.T. INCO) was brought into first-stage operation. The first parts of the P.T. Krakatau Steel integrated steelworks were being readied for production at yearend 1976. Freeport Indonesia Inc.'s Erstberg copper mine in Irian Jaya (formerly New Guinea) had a good year, although the matter of whether or not to go underground was not settled. The cement industry moved ahead on its program to raise annual capacity to about 6 million tons before 1980, more than triple the 1976 output.

The Indonesian Government issued new regulations in early 1977 that provide a basis for negotiating "third-generation" mining contracts. No mining contracts had been signed with foreign companies in more than 4 years, and there was need to revitalize mining activity. Rio Tinto-Zinc Corp. Ltd. was expected to sign the first third-generation contract with the Indonesian Government. The agreement would entitle P.T. Rio Tinto Indonesia to exploration and mining rights for base metals in a 6,500-square-mile area in Central Sulawesi for 30 years. At least 51% of the company's shares is to be tendered to the Government within 10 years after mineral production begins. An undisclosed percentage of foreign exchange earnings from mining exports may be retained in a special account to be used for jointly agreed purposes. A 10% export tax on unprocessed minerals would be assessed. Equipment may be imported free of duty and transfer/sales taxes for a period of 10 years. An additional 5% of all capital costs would be deductible annually for the first 4 years. Corporate income tax would be 35% per year for 10 years and 45% per year thereafter. Royalties and land fees would have to be paid. There would be a windfall clause, according to which a 60% tax is charged when average profits exceed 15% of invested capital for a period of 3 years. This contract was expected to be the model for other mining contracts. Subsequently, at least two similar contracts were being negotiated, one involving Taiwan interests and another, Hong Kong interests.

Production-sharing agreements have been employed, initially in oil and later in coal. Pertamina's financial crisis triggered a move to revise oil contracts, and new terms were issued in July and August 1976. Prior to July 1976, firms operated on the basis of a 40% in-kind cost recovery allowance and a 65–35 split in net operating income. The new terms revised both concepts. In the recovery of costs, companies were divided into two categories based upon the amounts of reserves; cost writeoffs became more complicated and were thereby reduced. The profit-sharing split became 85–15. Including the inroads on costs, the effective split came closer to 89–11. The new terms substantially altered cash flows and forced contractors to review ongoing and future exploration and/or development programs.

The revised contract terms provided $640 million in additional Government revenues, but raised doubts about Indo-

nesia's oil investment climate. When exploration activities subsequently slowed, it became evident that the terms must be modified. Pertamina issued an announcement on February 11, 1977, concerning granting of exploration incentives. Oil to Pertamina would be priced at market level for 5 years. A 20% credit of the capital investment cost directly related to development of new fields would be deductible from gross output in the first year of production, and additional taxes would be reduced. The United States Internal Revenue Service (IRS) issued a ruling on May 7, 1976, which affected Indonesian production-sharing contracts. The ruling stated that the share of production retained by Pertamina is judged to be a royalty in its entirety and is therefore not eligible for a foreign tax credit in the United States. The Indonesian Government was trying to find a solution to this important taxation issue to remove a major impediment to further exploration and development spending by U.S. oil companies.

On July 14, 1976, the IRS issued a second announcement, noting that payments to a foreign government by U.S. taxpayers owning minerals in place (oil producers in this instance) would be treated as creditable income tax if all of the following characteristics were present: Income tax is calculated independently of royalty and other foreign taxes; income tax payable under foreign law is based upon income receipts realized in a manner consistent with U.S. income tax principles; taxpayers' income tax liability cannot be discharged from property owned by the foreign government; foreign income tax liability, if any, is computed on the basis of all operations within the foreign country; the taxpayer, in computing the income subject to foreign income tax, is allowed to deduct, without limitation, the significant expenses incurred by him; and reasonable limitations of the recovery of capital expenditures are acceptable.

PRODUCTION

Indonesia's mineral production showed sharp increases in cement, ammonia, petroleum, natural gas, and refined tin; small increases in copper and nickel; and slight reductions in bauxite, iron sands, coal, mine tin, and precious metals. Radical expansion of cement capacity was gaining momentum and other construction materials, such as granite, did well also. Oil sales rebounded and established a record high, with large exports of low-sulfur crude to the United States. Despite a very impressive gain in natural gas output (about 25% furnished by Pertamina), more than half was still flared. Development of the petrochemical and fertilizer industries made significant headway. Production of nickel matte and ferronickel began; ore was formerly the only nickel material produced and exported. Mine copper output increased 10% in tonnage, but low prices held the value below the 1975 level. Indonesia's tin, oil, and gas are of considerable world consequence, and nickel and fertilizers are potentially so.

Table 1.—Indonesia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum, bauxite, gross dry weight ---thousand tons--	1,290	993	940
Copper, mine output, metal content	r 65,478	62,723	69,070
Gold metal [1] ---troy ounces--	r 76,491	74,954	85,690
Iron and steel, iron sand, dry basis	r 365,206	352,991	292,334
Manganese ore	r 18,037	13,682	9,833
Nickel:			
Mine output, metal content [2]	21,093	15,421	21,211
Ferronickel	--	--	16,886
Silver [1] ---thousand troy ounces--	r 1,138	1,033	1,072
Tin:			
Mine output, metal content	r 25,709	25,337	23,435
Metal	15,066	17,826	23,322
NONMETALS			
Asbestos	283	--	--
Cement, hydraulic ---thousand tons--	r 829	1,089	1,804
Clays:			
Kaolin powder	25,972	30,528	29,323
Other (for cement manufacture) ---thousand tons--	219	271	308
Diamond:			
Industrial e ---thousand carats--	12	12	12
Gem e ---do---	3	3	3
Total e ---do---	15	15	15
Fertilizer materials:			
Crude, phosphate rock	5,563	7,902	7,565
Manufactured:			
Nitrogenous	111,626	402,440	366,327
Other including mixed	117,020	116,635	75,033
Ammonia	3,007	58,728	224,952
Iodine ---kilograms--	25,933	33,007	27,290
Salt, all types ---thousand tons--	70	52	213
Stone:			
Marble ---cubic meters--	13,520	19,828	25,944
Limestone [3] ---thousand tons--	1,114	1,374	2,121
Granite ---do---	425	635	804
Quartz	r 62,688	139,613	165,219
Sulfur, elemental [4]	r 2,193	3,944	3,483
MINERAL FUELS AND RELATED MATERIALS			
Asphalt rock, bitumen content	75,170	115,679	104,990
Carbon black	2,916	2,682	e 3,100
Coal ---thousand tons--	156	206	183
Gas, natural:			
Gross production ---million cubic feet--	r 202,423	222,227	312,368
Marketed ---do---	34,801	82,224	126,426
Natural gas liquids:			
Propane and butane e ---thousand 42-gallon barrels--	12	r 12	70
Natural gasoline e ---do---	38	r 38	
Petroleum:			
Crude ---do---	501,838	477,055	550,319
Refinery products:			
Gasoline ---do---	14,042	15,759	9,763
Jet fuel ---do---	1,510	1,100	589
Kerosine ---do---	22,036	22,425	13,818
Distillate fuel oil ---do---	19,088	20,903	15,215
Residual fuel oil ---do---	12,159	11,820	8,036
Lubricants ---do---	32	31	14
Other:			
Liquefied petroleum gas ---do---	194	336	291
Petroleum wax ---do---	788	284	267
Naphtha ---do---	4,384	3,409	1,835
Unfinished oils requiring further processing ---do---	43,694	32,570	29,961
Unspecified ---do---	1,193	2,361	1,145
Refinery fuel and losses ---do---	6,387	2,381	2,411
Total ---do---	125,507	113,379	83,345

e Estimate. p Preliminary. r Revised.

[1] Includes gold and silver content of copper ore and output by Government-controlled operations. Gold output by operators of so-called "People's" mines is unavailable, but may be as much as 30,000 troy ounces per year.

[2] Includes a small amount of cobalt which is not recovered separately.

[3] Data represent quantities of limestone used for cement production. Excludes considerable amounts of limestone produced by enterprises under local jurisdictions for building materials, for crushed rock to be used as aggregate, and to burn for lime.

[4] Sulfur produced by other than Frasch process.

TRADE

Indonesia's strong balance-of-payments position improved further in 1976 as a result of increased oil exports and realistic handling of Pertamina's financial problems. Total exports increased from $7,103 million in 1975 to $8,547 million in 1976; total imports rose less sharply, from $4,770 million in 1975 to $5,673 million in 1976.

As expected, the largest share of Indonesia's trade has been with Asia. In 1976, 54.8% of all exports went to Asian countries and 53.0% of the imports came from Asian countries. Imports from Japan alone were $1,485 million in 1976, and exports to Japan were $3,564 million. The United States was Indonesia's second most important trading partner, with imports valued at $988 million and exports at $2,452 million. Imports from Europe totaled $1,340 million in 1976, whereas exports totaled a mere $704 million.

Equipment and machinery represented about 40% of all imports in 1976. However, base metals aggregated 14%; mineral products, 9%; and chemical products, 8%.

Minerals, particularly oil, continued to be of overriding importance in total exports. Oil represented 70% of all 1976 exports in value, and other minerals accounted for an additional 3.4%. Gross receipts from Indonesia's mineral exports are as follows, in million dollars:

	1974	1975	1976
Petroleum	5,211	5,311	6,004
Tin	173	154	165
Copper concentrate	125	74	80
Nickel ore	14	21	29
Bauxite	7	6	13
Other minerals	3	4	5
Nonminerals	1,892	1,533	2,251

Mineral exports and imports are shown in tables 2 and 3, respectively.

Table 2.—Indonesia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite and concentrate	1,260,971	973,370	All to Japan.
Metal including alloys, all forms	--	90	Pakistan 62; Singapore 21.
Copper:			
Concentrate, gross weight	239,946	199,581	Japan 149,386; West Germany 50,195.
Scrap	1,967	--	
Iron and steel metal:			
Scrap	18,179	1,580	All to Singapore.
Pig iron, including cast iron	--	1,813	All to Hong Kong.
Semimanufactures	--	1,265	All to Singapore.
Lead ore and concentrate	--	150	All to Malaysia.
Manganese ore and concentrate	388,762	310,841	Japan 307,641.
Nickel ore and concentrate	928,368	639,020	All to Japan.
Silver metal including alloys-troy ounces	184,545	72,725	United Kingdom 32,151; West Germany 24,113.
Tin:			
Ore (including slag and ash)	11,752	10,056	Malaysia 9,542; Japan 514.
Metal including alloys, all forms:			
Scrap	1,054	2,965	Japan 1,237; Netherlands 762.
Unwrought	15,412	5,772	Japan 2,260; United States 1,343; Netherlands 1,016.
Semimanufactures	--	5,517	Netherlands 1,826; Japan 1,768; United States 1,523.
Zinc metal:			
Scrap	--	134	Japan 84; Singapore 50.
Unwrought and semimanufactures	--	945	Japan 743.
NONMETALS			
Barite	--	35,011	Malaysia 10,025; Burma 2,498.
Clays, kaolin	--	1,710	Japan 1,630; People's Republic of China 80.
Fertilizer materials:			
Manufactured, nitrogenous	--	921	Malaysia 543; Singapore 359.
Ammonia	--	352	Singapore 249; Thailand 103.
Stone, sand and gravel:			
Crude and partly worked, granite	--	82,409	United States 82,406.
Gravel and crushed rock	--	9	All to Singapore.
Other:			
Bromine, iodine, fluorine	--	9	Japan 5; Australia 4.
Slag, dross, similar waste from iron and steel manufacture	--	169	All to Singapore.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	--	2,783	United States 1,561; Japan 479; France 380.
Petroleum:			
Crude—thousand 42-gallon barrels	405,134	397,261	Japan 189,980; United States 127,749; Trinidad and Tobago 36,696.
Refinery products:			
Gasoline, motor ——do——	258	825	Japan 472; Singapore 169.
Kerosine, white spirit ——do——	69	18,368	Japan 10,881; United States 3,863.
Distillate fuel oil ——do——	578	--	
Residual fuel oil ——do——	38,413	6,928	Japan 4,830; Netherlands 672.
Lubricants ——do——	--	6	Singapore 4.
Other:			
Paraffin wax ——do——	587	2,432	Japan 1,628; United States 534.
Nonlubricating oils ——do——	--	55,458	Singapore 55,456.
Total ——do——	39,905	84,017	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	--	8	All to Singapore.

Table 3.—Indonesia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	5	2	All from People's Republic of China.
Oxide and hydroxide	6,362	4,804	Japan 1,974; Singapore 1,010; India 1,000.
Metal including alloys:			
Scrap	63	147	Canada 127; People's Republic of China 20.
Unwrought	4,701	6,995	Japan 2,357; Canada 1,092.
Semimanufactures	21,061	15,854	Japan 9,217; Australia 763.
Arsenic trioxide, pentoxide, acids	106	43	Japan 14; France 11.
Chromium oxide and hydroxide	56	70	West Germany 29; Japan 14.
Cobalt oxide and hydroxide	9	11	Netherlands 7; Japan 4.
Copper:			
Matte	5	--	
Copper sulfate	61	105	West Germany 25; Taiwan 20; Belgium-Luxembourg 16.
Metal including alloys, all forms	6,751	7,083	Japan 3,477; West Germany 1,284.
Iron and steel:			
Ore and concentrate	50	13	Sweden 10; Singapore 3.
Scrap	12,739	16,043	Japan 8,454; Taiwan 5,000; North Korea 1,500.
Pig iron, ferroalloys, similar materials	9,532	11,518	Taiwan 10,310.
Steel, primary forms	187,203	95,518	Japan 43,713; Australia 9,470; Republic of Korea 7,121.
Semimanufactures:			
Bars, rods, angles, shapes, sections	425,293	351,224	Japan 250,270; Taiwan 39,559; Belgium-Luxembourg 10,981.
Universals, plates, sheets	339,347	344,334	Japan 304,455.
Hoop and strip	38,317	35,196	Japan 30,096; Taiwan 4,658.
Rails and accessories	18,676	27,840	Japan 11,288; West Germany 7,832; Australia 5,499.
Wire	17,560	7,113	Japan 5,715.
Tubes, pipes, fittings	163,128	201,586	Japan 125,837; United States 21,559.
Castings and forgings, rough	1,378	6,255	Japan 3,591; United States 2,635.
Lead:			
Oxides	r 492	469	Australia 346; United Kingdom 49.
Metal including alloys, all forms	2,235	3,589	Australia 2,540; Japan 579.
Magnesium metal including alloys, all forms	7	160	Japan 105; People's Republic of China 50.
Manganese:			
Ore and concentrate	3,281	4,802	Singapore 2,526; Congo 2,100.
Oxides	3,464	1,685	Japan 1,248; Netherlands 400.
Mercury ----------76-pound flasks	r 382	684	Japan 390; West Germany 226.
Nickel metal including alloys, all forms	1,954	1,345	Japan 1,290.
Platinum-group metals including alloys, all forms ----------thousand troy ounces	(1)	198	Netherlands 66; Singapore 32.
Tin:			
Oxide	411	200	Mainly from Poland.
Metal including alloys, all forms	188	154	Japan 70; Singapore 38.
Titanium oxides	4,798	3,931	Japan 2,076; Australia 688; West Germany 574.
Tungsten metal including alloys, all forms	68	12	Japan 10.
Uranium and thorium oxides, including rare-earth oxides	17	--	
Zinc:			
Oxide	2,628	1,533	Australia 598; Japan 278; People's Republic of China 126.
Metal including alloys:			
Scrap and blue powder	866	875	Australia 698; Japan 155.
Unwrought and semimanufactures	22,253	21,760	Australia 14,655; Japan 4,549.
Other:			
Ores and concentrates	--	69	Australia 63.
Ash and residue containing nonferrous metals	25	12	Japan 10; Singapore 2.
Oxides, hydroxides, peroxides of metals, n.e.s	238	399	Netherlands 200; United States 123.
Metals including alloys, all forms:			
Metalloids	r 82	18	Mainly from West Germany.

See footnotes at end of table.

Table 3.—Indonesia: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Other—Continued			
Metals including alloys, all forms—Continued			
Alkali, alkaline earth, rare-earth metals	93	94	United Kingdom 50; Australia 25; Japan 15.
Pyrophoric alloys, ferrocerium	51	12	Singapore 10.
Base metals including alloys, all forms, n.e.s	29	74	Japan 29; People's Republic of China 23.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	288	418	Greece 110; Netherlands 109; Japan 63.
Dust and powder of precious and semiprecious stones	9	1	Mainly from United States and France.
Grinding and polishing wheels and stones	617	369	People's Republic of China 83; Taiwan 74; Japan 64.
Asbestos	6,488	4,845	Canada 2,073; Singapore 734; People's Republic of China 600.
Barite and witherite	62,506	69,730	Thailand 51,992; United States 7,781.
Boron materials:			
Crude natural borates	190	149	United States 83; Singapore 65.
Oxide and acid	84	254	United States 164; West Germany 26; United Kingdom 22.
Cement—thousand tons	1,738	1,609	Japan 754; Republic of Korea 369; Thailand 240.
Chalk	429	525	United States 235; Philippines 199; Japan 51.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	--	4,781	Singapore 2,488; United States 2,056.
Kaolin	--	5,769	Malaysia 2,003; Japan 1,691; United States 1,354.
Kyanite	17,241	41	All from Philippines.
Other	--	4,008	United States 2,988.
Products:			
Refractory (including nonclay bricks)	r 15,135	18,927	Japan 3,731; People's Republic of China 2,901.
Nonrefractory	7,525	4,319	Japan 2,398; Singapore 536; People's Republic of China 462.
Cryolite and chiolite	31	15	All from People's Republic of China.
Diamond, industrial—carats	--	27,240	All from Australia.
Diatomite and other infusorial earth	337	463	United States 136; Republic of Korea 120; Japan 110.
Feldspar, leucite, nepheline	1,355	1,144	India 500; Italy 250; Thailand 249.
Fertilizer materials:			
Crude:			
Nitrogenous	7,081	915	Netherlands 500; Belgium-Luxembourg 400.
Phosphatic	3	11	United States 9; Malaysia 2.
Potassic	1,687	1,401	United States 1,000; Singapore 400.
Manufactured:			
Nitrogenous	815,126	751,739	Japan 170,126; Poland 90,523; Kuwait 79,500.
Phosphatic	253,130	388,701	United States 138,363; Singapore 60,143; Netherlands 47,906.
Potassic	72,109	28,733	Canada 12,796; West Germany 10,157.
Other, including mixed	11,752	28,141	United States 15,865; Singapore 7,717.
Ammonia	124	69	Japan 23; Singapore 23; Netherlands 15.
Graphite, natural	142	165	Japan 89; People's Republic of China 52.

See footnotes at end of table.

Table 3.—Indonesia: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Gypsum and plasters	32,306	47,556	Thailand 20,801; Australia 15,535; Japan 9,894.
Lime	5,410	2,690	Japan 1,595; Singapore 714; United Kingdom 256.
Magnesite	179	45	Japan 25; United States 15.
Mica, all forms	999	1,044	Japan 600; United States 378.
Pigments, mineral:			
Natural, crude	539	227	People's Republic of China 224.
Iron oxides, processed	r 1,026	645	West Germany 299; People's Republic of China 252.
Precious and semiprecious stones, except diamond, manufactured ----------value	$23,000	$24,000	All from West Germany.
Pyrite	43	4,967	All from Philippines.
Salt and brine	12,213	181,246	India 95,968; Australia 68,453; Thailand 14,043.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	27,073	46,619	Japan 10,399; Taiwan 9,343; United States 6,811.
Caustic potash, sodic and potassic peroxides	6,128	4,419	Japan 2,309; West Germany 941.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	25,468	1,710	Malaysia 1,035; Burma 450; People's Republic of China 157.
Worked	r 3,918	2,862	Japan 1,092; Singapore 667; People's Republic of China 521.
Dolomite, chiefly refractory grade	2,656	1,625	Taiwan 1,500.
Gravel and crushed rock, n.e.s	1,151	433	France 253; Malaysia 86.
Limestone (except dimension)	901	225	People's Republic of China 125; Taiwan 83.
Quartz and quartzite	311	101	People's Republic of China 60; Taiwan 24.
Sand, excluding metal bearing	r 4,965	2,045	United States 758; Malaysia 697; Singapore 269.
Strontium minerals	1,078	425	People's Republic of China 322.
Sulfur:			
Elemental:			
Other than colloidal	28,843	1,125	Singapore 613; People's Republic of China 323.
Colloidal	13,550	12,166	Canada 5,250; Japan 5,067.
Sulfur dioxide	25	13	West Germany 12.
Sulfuric acid, oleum	1,199	571	Singapore 523; Netherlands 36.
Talc, steatite, soapstone, pyrophyllite	6,115	5,138	People's Republic of China 3,756; Republic of Korea 623.
Other nonmetals, n.e.s.:			
Crude	r 3,255	27	France 25.
Slag, dross, similar waste, not metal bearing	349	101	Egypt 100.
Oxides and hydroxides of magnesium, strontium, barium	973	114	Japan 31; United States 31; United Kingdom 27.
Bromine, iodine, fluorine	216	13	Japan 9.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	17,641	21,067	Singapore 13,182; Republic of Korea 4,500; People's Republic of China 3,300.
Carbon black and gas carbon:			
Carbon black	9,263	9,180	Australia 6,223; Japan 2,145.
Gas carbon	1,480	51	France 40; West Germany 11.
Coal, all grades, including briquets	424	13,461	Vietnam 13,380.
Coke and semicoke	18,184	15,666	Japan 8,063; People's Republic of China 6,795.
Gas, hydrocarbon, manufactured	74	--	
Hydrogen and rare gases	179	44	Japan 31.
Peat, including peat briquets and litter	57	--	
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	1,382	3,333	Singapore 1,957; U.S.S.R. 409.
Refinery products:			
Gasoline, motor spirit ---------do	33	447	Singapore 432.
Kerosine and white spirit ----do	3,002	3,374	Singapore 1,897; U.S.S.R. 739.
Distillate fuel oil ----------do	445	970	Singapore 819.

See footnotes at end of table.

Table 3.—Indonesia: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum—Continued			
Refinery products—Continued			
Residual fuel oil thousand 42-gallon barrels	5,704	5,395	Singapore 3,421.
Lubricants (including grease) do	355	721	Japan 422; Singapore 149.
Other:			
Liquefied petroleum gas do	5	62	Singapore 61.
Mineral jelly and wax do	27	11	People's Republic of China 2; United States 1.
Nonlubricating oils, n.e.s do	129	1,032	United States 390; Singapore 174; Malaysia 159.
Bitumen and other residues and bituminous mixtures, n.e.s. do	1,509	1,240	Singapore 720; People's Republic of China 212.
Pitch, pitch coke, petroleum coke do	6	21	Mainly from Singapore.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	1,990	1,963	Singapore 699; Japan 663; United Kingdom 235.

r Revised.
1 Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum and Bauxite.—P.T. Aneka Tambang's bauxite mines on Bintan Island near Singapore produced at a rate slightly lower than in 1975. The same mines producing 1.2 million to 1.3 million tons annually a few years ago turned out less than 1 million tons per annum in 1975 and 1976. All the bauxite has been destined for Japan, which of late has cut back on purchases from Indonesia. Aneka Tambang continued to move ahead on a $400 million alumina project on Bintan to produce 600,000 tons of alumina annually. The U.S.S.R. had offered a $300 million loan, only to withdraw the offer subsequently. Kaiser Engineers Inc. was then employed to study the project, on the basis of a 27-million-ton reserve of high-silica trihydrate bauxite at the mine site and a little more in surrounding areas. Indonesia is geologically most promising for finding additional bauxite. The hope is to sell 450,000 tons of alumina annually to the Asahan aluminum complex and provide 150,000 tons for export, possibly to the Middle East, by the early 1980's.

The Asahan aluminum project has become a symbol of Indonesian-Japanese economic cooperation,[4] and is the most important project in Indonesia's second 5-year plan. The Japanese view it not only as a great technical challenge but as a source of low-cost aluminum, produced with power costing only about 1.3 yen per mil. (US$1 equals 297 yen in 1976 and 279 yen in July 1977.) Virtually all of the large Japanese aluminum producers have banded together into a consortium to work on the 250-billion-yen project. Construction costs, including infrastructure and research expenses, were estimated at 80.3 billion yen for electric power development, 149.1 billion yen for aluminum smelting facilities, and 20.6 billion yen for long term working funds.

Half of the potential power of Asahan River in North Sumatra will be developed (a maximum of 243,000 kilowatts at Sigura-gura and 271,000 kilowatts at Tangga). The aluminum plant will use 410,000 kilowatts, leaving surplus electricity for general distribution. The powerplant site is near Toba Lake, a sightseeing resort 260 kilometers from the port of Belawan. The aluminum plant will be at Kualatandjung, 120 kilometers from the powerplant and 45 kilometers east of Tebingtinggi. Initial capacity of 75,000

[4] Japan Chemical Week (Tokyo). July 1, 1976, pp. 4–5.

tons per year in 1981 is expected to be expanded to 225,000 tons per year by 1984. More than 800,000 tons of cargo will be shipped in and out of the plants, which explains the need for improving port facilities. The Bintan alumina complex and the Asahan aluminum and power complex are expected to become the foundation of Indonesia's emerging power, chemical, and heavy industries.

Chromite.—Indonesian and Japanese interests have recently joined hands to investigate chromite in Sulawesi. Kanematsu-Gosho Ltd., Kawasho Corporation, and Chugai Mining Co., Ltd., formed a company called Japan Sulawesi Chrome Development Ltd. for this purpose. The project calls for an initial outlay of $1 million (to be borne by the Japanese) in the next 2 years for exploring an area 35 miles south of the port of Parepare. The Indonesian firm, P.T. Perto, has the mining rights to an 80,000-square-mile site. Preliminary surveys indicate a 200,000-ton chrome deposit grading 38% Cr_2O_3. If subsequent drilling confirms its viability, a joint venture will be established, with Japanese firms funding 40% and Perto 60%. Initial output could be 20,000 to 40,000 tons of chrome product annually.[5]

Copper.—Indonesia's only primary copper producer, Gunung Bijih (or Erstberg), located in Irian Jaya and owned by Freeport Indonesia, Inc. (8.5% Indonesian Government), had a slightly better-than-average year, producing 223,300 tons of 30% copper concentrate. Exports increased 9% in tonnage, reaching nearly 67,000 tons of contained copper in 1976, of which two-thirds was shipped to Japan and one-third to West Germany. This open pit mine in the mountains, with concentrates slurried down to the port of Amampare, may be worked underground in the future if copper prices hold up. Initial underground surveys show promise, and a 2-kilometer tunnel was being driven to facilitate collection of samples. This phase of exploration should be completed by yearend 1978. A final decision as to whether or not to go ahead with underground mining probably will not be made until later, although Fluor Corp. (United States) has been engaged to explore the Pegunungan Jaya Wijaya Mountains, the underground site.

Significant interest in exploring for copper continued in several areas of the archipelago. P.T. Tropic Endeavour, under a work contract, was exploring in the Gorontalo area of northern Sulawesi. South Sulawesi Mining Corp. had a work contract to explore in its area. Aneka Tambang, drilling a large base metals deposit in West Java, had investigations underway in Sulawesi, Lampung, and West Kalimantan. A local firm, C.V. Disco, holding five work contracts, was exploring for base metals with assistance from Taiwan Metal Mining Corp. P.T. Wall had contracted for preliminary geological and geochemical work in East Nusatenggara.

Gold and Silver.—Aneka Tambang's mine in Cikotok, southern Banten, West Java, continued to be the only important primary gold producer in Indonesia. However, its output in 1976 was only about 11,000 troy ounces of gold and 100,000 troy ounces of silver. Unrecorded production from small mines in Kalimantan and Sumatra may be several times the recorded levels. Byproduct precious metals from the copper concentrates of Erstberg, also unrecorded, may total 70,000 troy ounces of gold and 800,000 troy ounces of silver.

Iron and Steel.—Indonesia's 1976 steel developments concern P.T. Krakatau Steel, with facilities at Cilegon in West Java. Krakatau has a long, checkered history, having been started with U.S.S.R. aid in 1962. Idle for 7 years beginning in 1965, the project was resumed once more in 1972 under the aegis of Pertamina and managed by Manderstan Associated Consultants of Geneva, Switzerland. The project was taken out of the Pertamina ambit in 1975, when Krakatau was reorganized, and Kaiser Engineers and Armco Steel Corp. were brought in to help. Foreign exchange commitments were reduced from $2.1 billion to $1.1 billion when the project was basically redesigned. In 1976, West Germany signed a contract to supply a credit of 1.2 billion Deutsche marks to support the project. At yearend 1976, two small parts of the project were being readied for operation —a 150,000-ton-per-year reinforcing rod mill and a 100,000-ton-per-year steel angle mill. Already, $150 million had been spent for these mills and a port for Krakatau.

[5] World Mining (San Francisco). July 1977, p. 78.

The mills will be part of an integrated steel complex, aimed at producing 2.2 million tons of steel products per year by 1985, the last year of phase 4. The hope is to complete phase 1 in 1979, when 1 million tons of sponge iron will be produced by the HyL direct-reduction process using Australian iron ore and natural gas from Central Java. Half of the sponge iron will be sold and the other half processed into billets and then wire, bars, and shapes. Indonesian demand for steel increased from about 400,000 tons in 1967 to 1,500,000 tons in 1976, and prospects for 1985 are that requirements will reach 3 million tons. Thus, justification for this steel project seems obvious, unless Indonesia continues to import large quantities of steel products and to flare its surplus gas.

The Indonesians hope eventually to develop some local iron ore; in 1976, the country continued to rely on high-grade imports from Australia. Locally, small quantities of iron sands (about 353,000 tons in 1975 and 292,000 tons in 1976) have been produced by Aneka Tambang east of Cilacap (Tjilatjap), along the south coast of Java. All of the sands, analyzing 55% to 57% iron and 9.5% to 11% titania, have been exported to Japan. In early 1977, consideration was given to the exchange of Indonesian oil for Brazilian high-grade iron ore to meet part of Krakatau's future iron ore needs.

Nickel.—Until Indonesia develops a strong steel industry, its nickel supply will continue to be totally export oriented. Such prospects are not in sight for at least a decade. Until yearend 1976, all of the nickel extracted was exported as ore by Aneka Tambang, which operates a nickel mine at Pomalaa in southeast Sulawesi. In 1976, the Pomalaa mine produced nearly 830,000 tons of 2.4% nickel ore for export to Japan; Japan received 811,684 tons during the year, and would like to cut imports by at least 10% in the coming year. Aneka Tambang's new 20,000-ton-per-year ferronickel smelter (4,500 tons of contained nickel) commissioned in October 1976 was designed to use the lower-grade ore at Pomalaa, with the final product also destined for export. Indonesia has extensive and widespread resources of high-moisture (generally more than 25%) nickeliferrous laterites in Sulawesi and elsewhere.

P.T. INCO, owned 75% by the International Nickel Co. of Canada Ltd. (with provision to sell 20% of this to Indonesians after start of production) and 25% by Japanese firms, started phase 1 production at its Soroako project on Sulawesi in September 1976. Seven local deposits were being developed to supply 2.2% nickel ore for the smelter. Phase 1 capacity is 37 million pounds of contained nickel in 75%-grade nickel matte (sulfur comes from Canada), to be increased in phase 2 at yearend 1978 to 107 million pounds with the addition of two similar process lines. Ore is mined selectively and upgraded by vibrating grizzlies to reject large barren rock. It is then dried, screened, and blended before feeding into a 100-meter (328-foot) reduction kiln where sulfur is injected at the discharge end. The reduced product is made into a 25% nickel matte in an electric furnace and then upgraded in a top-blown rotary convertor to a 75% nickel matte final product. A 165,000-kilowatt hydropower plant on the Larona River was being built to meet the needs of phase 2, when a total of 4,000 workers will be employed. Actually, there may be 8,000 workers, mostly construction workers, on the site as of early 1977, so that Soroako has become quite a community in a formerly sparsely inhabited land. The total capital cost has been steadily revised upward, with the latest figure at $850 million, comprising one-third equity and two-thirds loans. Sales will be mainly to Japan, with some eventually aimed at the People's Republic of China market.

P.T. Pacific Nikkel Indonesia's project on Gag Island near the "bird's head" of Irian Jaya continued to have good hope of realization. If its plans are eventually implemented, Indonesia would become the third leading nickel producer among market economy countries, after Canada and New Caledonia, by the 1980's. Pacific Nikkel had already spent $40 million on this project, which may cost $1 billion to implement. United States Steel Corp. and the Dutch steelmaker, Hoogovens IJmuiden B.V., are the mainstays of the consortium, with the Indonesian Government agreeing to take 20% equity for World Bank financing purposes. However, New-

mont Mining Corp. and Sherritt Gordon Mines Ltd. withdrew from the venture, and Amoco Minerals Co. (a subsidiary of Standard Oil Co. of Indiana) subsequently agreed to equity participation. Another new partner was being sought, so as to qualify Pacific Nikkel for a $50 million World Bank loan by yearend 1977. The original consortium had a 30-year work contract dating from 1969. Early studies indicated 260 million tons of 1.5% nickel ore, but the reserve could be much greater. Projected annual output for the early 1980's is approximately 110 million pounds of nickel powder or briquets, and 2 million pounds of nickel and 1 million pounds of cobalt contained in mixed sulfide concentrates.

The project of the Indonesian Nickel Development Co. (INDECO) on Gebe Island near Halmahera apparently will be shelved indefinitely by an eight-member Japanese consortium. The original plan was to build a 20,000-ton-per-year ferronickel plant locally. INDECO had already spent nearly $10 million, but decided to reconsider when cost estimates doubled to $400 million to $500 million.

Tin.—Indonesia retained its position as the world's fourth ranking tin producer, and its producer votes in the International Tin Council (ITC) constituted 15.7% of the total in early 1977. The country's tin output was still far below past peak levels, and pressure was building to expand production and increase export quotas. Meanwhile, some of the newer companies, such as P.T. Koba Tin, were being restrained by existing tin quotas. Higher world tin prices near yearend did not stimulate Indonisia's tin production, because the Government is by far the principal producer (there being few small private operations) and costs spiraled in the face of sharp inflation. The country's tin exports in 1976, which reflect production value, were valued at about $165 million.

The State-owned tin company P.N. Timah was reorganized into a limited company in 1976, with the name changed to Perusahaan Terbatas Tambang Timah (P.T. Timah). The new company was granted wider powers and greater freedom, and Abdul Rachman Ramly was appointed president-director, replacing Major General Tajib. In 1975, P.N. Timah produced 24,391 tons of mine tin, 96.3% of the national total (70.4% from Bangka, 21.4% from Belitung, 7.4% from Singkep, and 0.8% from Bangkinang). The company's total production dropped slightly in 1976, because of operational difficulties related to inflation, but the pattern of output remained the same, with Bangka producing 16,066 tons, Belitung 4,716 tons, Singkep 1,270 tons, and Bangkinang 152 tons. P.T. Timah has 12 fixed dredges (9- to 18-cubic-foot) and 8 small dismantlable dredges on Bangka, 14 fixed dredges (5- to 14-cubic-foot) and 2 small dismantlable dredges on Belitung, and 4 fixed dredges on Singkep. P.T. Timah's reserves may be on the order of 500,000 tons of recoverable tin. A new 24-cubic-foot bucket dredge with an annual throughput of nearly 7 million cubic yards and a 150-foot digging depth, known as Bangka II, was being built for P.T. Timah by the United Kingdom firm F. W. Payne for service by 1979. Indonesia needs large strong dredges, since many operations are near shore or offshore.

N.V. Billiton Exploratie Maatschappij Indonesia, a subsidiary of the Royal Dutch/Shell Group, was having built at the Jurong shipyard in Singapore a $25 million dredge which was designed by Mining and Transport Engineering B.V. (MTE) of Amsterdam, the Netherlands. This deep (150-foot) yearround dredge, equipped with 30-cubic-foot buckets and capable of processing over 8 million cubic yards of gravel annually, will start working the Pulau Tujuh concession (between Bangka and Singkep Islands) by 1978 and expects to extract 2,500 tons of tin-in-concentrate per year. In addition to Pulau Tujuh, Billiton has another 40-year concession dating from 1968. Billiton offered 25% of the shares to P.T. Timah.

P.T. Broken Hill Pty. Indonesia, a subsidiary of Broken Hill Pty. Co. Ltd. (Australia), has been investigating since 1973 an old flooded underground lode mine (closed since 1942) on Belitung, called Kelapa Kampit. Reportedly, Broken Hill had spent as much as $10 million in trying to rehabilitate this mine, and was ready to give up on it in late 1976. However, a feasibility study on commercial operations was still being prepared. P.T Koba Tin, a joint venture between Australian interests and P.T. Timah (with 25% of the shares), continued gravel-

pump operations at its Nibung property, although temporarily shutting down its Lubuk-Besar property, both on Bangka Island. Koba Tin produced nearly 900 tons of mine tin in 1975, and had ordered two small bucket dredges.

The 31% increase in Indonesia's tin metal production to 23,322 tons in 1976 reflects the completion of the Peltim smelter at Mentok on Bangka Island. Mackay Consultants helped to install three new 6,000-ton reverberatory furnaces to complement three West German rotary furnaces that were producing at less than half of design capacity. The plant was capable of producing about 27,000 tons of tin annually as of yearend 1976. Thought was given to the replacement of the rotaries with a fourth conventional reverberatory furnace. P.T. Timah owns and operates the tin smelter, which smelts all of the country's mine tin.

Uranium.—Indonesia's national atomic energy agency has the authority to arrange for foreign participation under special agreements, although the law reserves all rights for the Government. French teams exploring West Kalimantan reportedly made some promising discoveries, prompting optimism to the effect that uranium mining might commence as early as 1980, despite difficult working terrain. The most promising location is Kalan, in the Nangapinoh district of Sintang Regency. Analysis of a 10-kilogram sample of the West Kalimantan ore showed an average of 0.3% uranium (may be U_3O_8) content. The French were hopeful that they would be selected to undertake mining for the ores they discovered. Prospects for finding commercial uranium deposits in southcentral Sumatra by the West Germans and in Kalimantan by the Indonesians also appeared good. Construction of a nuclear testing reactor at Serpong, West Java, was in progress.

NONMETALS

Cement.—Indonesia was on schedule in its program to expand cement production from less than 1 million tons per year in 1974 to about 6 million tons per year before 1980. Output in 1976 reached 1.8 million tons, an increase of 0.7 million tons over that of 1975. Demand increased sharply also, with many construction projects getting underway. Shortages were met by imports.

P.T. Semen Cibinong (Cibinong Cement Co.), 51% owned by Kaiser Cement & Gypsum Corp. (to be reduced to 44%), moved ahead on a $48 million expansion program to raise capacity of its newly built 500,000-ton plant in West Java to 1.1 million tons by mid-1977. Fuller Company (United States) was supplying necessary equipment, including a 15- by 220-foot rotary kiln, a 15- by 115-foot rotary dryer, a 12- by 33-foot raw mill, and a 12- by 33-foot finish mill. Allis-Chalmers Corporation, Fuller, and Polysius AG (West Germany) received equipment orders from Morrison-Knudsen Co., Inc., of San Francisco, Calif., for the P.T. Semen Gresik plant in East Java to triple capacity to 1.5 million tons by 1978. F. L. Smidth & Co. was awarded a contract from P.T. Semen Padang for construction of a 2,000-ton-per-day dry-process plant next to its existing Indarung wet-process facility in West Sumatra. Mitsui & Co. Ltd. started to build a 600,000-ton plant at Cilacap in Central Java. Various other cement projects were also underway.

Fertilizer Materials.—Indonesia's fertilizer supply picture, based mainly upon fixed nitrogen from the use of the abundant resources of natural gas, was undergoing significant change in 1976, as part of an overall program to greatly increase production and make the country more than self-sufficient in a few years. With its large population and emphasis on agriculture, particularly food crops, Indonesia has been a significant consumer of fertilizers for some time already, needing 300,000 to 400,000 tons of nitrogen annually. Imports of nitrogen reached a peak of 580,000 tons in fiscal year 1975–76, but were banned in the following year because of oversupply. Stocks at the beginning of 1976 were 644,000 tons,[6] but fell to 437,000 tons a year later. Production was about 250,000 tons in 1976 and should reach 600,000 tons by 1978. In 1976, Indonesia had 525,000 tons per year of urea capacity, was building to accommodate an additional 1,710,000 tons, and had firm plans to construct for another

[6] Nitrogen (London). Heralding a New Era in Indonesia. The British Sulphur Corp. Ltd. No. 106, March/April 1977, pp. 31–33.

1,140,000 tons. Ammonium sulfate capacity will be raised from 150,000 tons to 260,000 tons per year. A major restructuring has taken place in the Indonesian fertilizer industry, with responsibility passing from Pertamina to the Directorate General for Chemical Industries.

An ammonia-urea complex near Palembang in South Sumatra, known as Pusri III and rated at 272,000 tons per year of nitrogen as ammonia and 262,000 tons per year of nitrogen as urea (or 560,000 tons per year of urea), was completed by Kellogg Overseas Corp. at a cost of nearly $200 million near yearend 1976. The total urea capacity at this site, combined with that of Pusri I and Pusri II, was raised to 483,000 tons per year of nitrogen. Kellogg and Toyo Engineering Corporation will bring Pusri IV, which is identical to Pusri III, into production by 1979. Kellogg was also constructing a $250 million complex rated at 1,000 tons per day of ammonia and 1,725 tons per day of urea at Cikampek in West Java, with the help of a $200 million Iranian loan, for completion by yearend 1978 and to be operated by P.T. Kujang.

An Association of Southeast Asian Nations (ASEAN) regional fertilizer complex capable of producing 570,000 tons per year of urea, designed by the West German firm August Thyssen-Hütte AG, to be located at Aceh in North Sumatra, was past the drawing board stage. Construction of a compound fertilizer plant at Gresik for Petrokimia, rated at 80,000 tons per year of diammonium phosphate, 152,000 tons per year of P_2O_5 triple superphosphate, and 50,000 tons per year of nitrogen-phosphorus-potassium (NPK), was well underway and scheduled for completion by early 1979. Indonesia's only ammonium sulfate plant, with 31,000 tons per year of nitrogen capacity, is also located at Gresik. The scheme to construct a floating fertilizer plant off the coast of East Kalimantan was abandoned by the Indonesian Government for an onshore location and two specifically built ships will be scrapped or sold.

Clays.—*Kaolin.*—Kaolin occurs in various localities of Indonesia, either as a weathered product of feldspar in granitic rocks or formed as a result of hydrothermal activity. Output was 29,323 tons in 1976 compared with 30,528 tons in 1975. Belitung Island with 15 properties is the largest producer, followed by Bangka with 5 properties and North Sulawesi with 1 property.

P.T. Timah became interested in kaolin and other clays on Bangka and Belitung Islands, as part of a program to diversify. Most of the clays found so far are only intermediate in quality.

Stone.—*Marble.*—Mesozoic- to Tertiary-age marble of various grades occurs in a number of localities. The oldest enterprise is P.T. Industri Marmer Indonesia Tulungagung, which owns quarries in the Trenggalek and Tulungagung areas of East Java. The firm's output was 19,828 cubic meters of finished products in 1975 and 25,944 cubic meters in 1976. Another company has recently started to develop pre-Tertiary marble in the Banjarnegara area of Central Java.

Other Nonmetals.—Iodine has been produced in East Java since before World War II. The important current producer is P.T. Kimia Farma, whose plant at Mojokerto provided 33.0 tons of iodine in 1975 and 27.3 tons in 1976. Indonesian iodine was used in the pharmaceutical industry.

Sulfur deposits with 240,000 tons of reserves were recently discovered in the Sorikmerapi and Pahae districts of North Sumatra. The mountainous areas of Sibayak and Sinabung are also thought to possess workable sulfur deposits.

MINERAL FUELS

Coal.—Indonesia's new energy policy was expected to lay stress on the twin goals of continued expansion of oil reserves for export and the rapid development of nonoil energy resources, particularly coal, to meet the anticipated growth in domestic energy consumption. First, existing mines were scheduled to be expanded by P.N. Batubara, the State coal company. The Bukit Asam open pit mine, near Palembang in South Sumatra, produced only 120,000 to 130,000 tons in 1976, but will be expanded first to 800,000 tons per year and eventually to 2 million tons per year. Large-scale expansion at Bukit Asam must await approval of a $100 million World Bank loan; its planned markets would include the Baturaja cement plant, other industries in Palembang, the Muntok tin smelter, powerplants in Lampung Prov-

ince, and Cilincing on coastal Java. Another smaller mine is Ombilin (underground operation) near Padang in West Sumatra. These subbituminous coal mines can only provide coal for general use, and part of Ombilin's future output will go to Padang's Indarung cement plant.

Of far greater interest is the several-billion-ton deposit in Lampung Province of southern Sumatra, newly discovered by Shell Internationale Chemie Mijnbouw B.V. (the Netherlands). Shell completed a reconnaissance drilling program in mid-1976, and was planning to relinquish most of the contracted area granted for exploration. A production-sharing contract was signed with Batubara, with Shell committing over $1 billion. Future output would be related to export demand (mainly by Japan), and up to 25 million tons may eventually be produced annually, together with removal of several times that much in overburden. New railroads will have to be built, and port facilities need to be radically expanded.

Petroleum and Natural Gas.—Indonesia's oil production, which ranked 12th in the world in 1976, was up 15.4% from the 1,313,000 barrels per day (dividing by 7.348 will give the approximate equivalent in tons) in 1975. The bulk of this was exported as crude oil, which explains why Indonesia's refinery capacity is not particularly large. In 1976, Indonesia produced 550,319,000 barrels of crude oil, exported 449,226,000 barrels, and refined 113,698,000 barrels, of which it exported 36,255,000 barrels of refined oil products. Oil exports netted $6.0 billion in 1976, compared with $5.3 billion in 1975 and $5.2 billion in 1974. In 1976, 43% of Indonesia's crude oil exports went to Japan and 41% went to the United States. The radical price increase which occurred in 1973 had not been succeeded by any significant change by yearend 1976. (There was a price rise of nearly 6% on January 1, 1977.)

Near yearend 1976, P.T. Caltex Pacific Indonesia's share of national output was about 48%, down from 63% in 1975. Caltex's output did not show much change, whereas lesser companies made significant advances. Caltex produces low-sulfur Minas light crude, famed the world over. Caltex, with facilities mainly near the coast in Central Sumatra, produced 307 million barrels in 1976. Ranked next was Atlantic Richfield Indonesia Inc. (Arco) with 44 million barrels, followed by Independent Indonesian American Petroleum Co. (IIAPCO) with 34 million, Pertamina with 31 million, Total Indonesie with 29 million, Union Oil Company of Indonesia and Petromer Trend Corporation with 28 million each, Japex Indonesia Ltd. with 19 million, and P.T. Stanvac Indonesia with 13 million. During 1976, U.S. companies produced about 85% of Indonesia's oil.

An integrated oil company involved in exploration, production, marketing, and refining operations, Pertamina's influence goes far beyond the usual lines of oil enterprise, since this State-owned company is also the Indonesian Government's representative in all oil ventures, programs, and regulatory efforts. In addition, Pertamina was involved in projects related to airplanes, ships, hotels, office buildings, steel, and fertilizers. During 1976, the Government made considerable progress in managing Pertamina's debt, which initially ran up to more than $10 billion. Local currency obligations were substantially reduced and 12 tanker contracts were resolved. Pertamina continued to streamline operations in an effort to concentrate more exclusively on oil-related activities, and several changes in the board of directors were announced.

During 1976, the Government virtually scrapped its longstanding production-sharing contract system. Original contracts provided for a recovery of investments by operators from the first 40% of output. About 20% of production was turned over to refineries operated by Pertamina at just above cost. The remainder was split 65–35 (sometime less evenly), with additional excess profit tax imposed upon operator sales. The IRS ruled that Pertamina's share of oil was to be treated like a royalty, of which only half was deductible, rather than as a tax payment, which is fully deductible. This prompted the Indonesian Government to revise contract terms to make production-sharing oil value fully deductible as tax payments. New contracts were drawn up which in effect give the Government 88% to 89% of the take from foreign operators' production; companies were placed in 7-year and 14-year cost-recovery groups. The new contract system was an attempt to net more

income for Indonesia, but instead had the effect of slowing down exploration, which hit bottom at yearend 1976. In early 1977, the Indonesian Government was attempting to develop a formula of economic incentives to revitalize exploration drilling and attract new operators to the Indonesia arena. Pertamina was considering asking foreign oil firms to explore and develop certain Pertamina fields on a joint-venture basis.

Foreign contractors, along with Pertamina, completed 142 new exploratory wells, of which 43 succeeded in discovering new sources of oil and gas. Total exploratory footage drilled in 1976 was 748,000 feet, down 31% from the previous year. Development drilling footage was reported at 1,550,000 feet, also an appreciable drop. In 1976, companies spent $1.1 billion on the search for oil and gas, and the outlook for 1977 and early 1978 calls for this depressed level of activity to continue.[7] The country's oil reserves were estimated at about 10.5 billion barrels, and gas reserves at 24 trillion cubic feet. Field depletion in Indonesia, however, is generally more rapid than in some other areas, and to maintain growth more reserves will need to be tapped.

Caltex operates the giant Minas Field at 350,000 barrels per day and discovered some small fields near Minas recently. Stanvac, a longtime operator in Indonesia, reported no significant developments. Arco's four producing structures off the northwestern coast of Java, known as Ardjuna Fields, increased production to more than 100,000 barrels per day. A newcomer to East Kalimantan, Huffco increased output to 13,000 barrels per day from Badak and other fields. Badak has a potential capacity of 50,000 barrels per day of oil, and was trying to supply 550 million cubic feet per day of gas for an LNG plant. Petromer Trend had boosted production to 90,000 barrels per day from fields in the Vogelkop region of Irian Jaya. Of Petromer Trend's fields, Walio had the best potential. Mobil Oil Indonesia Inc., which discovered the huge Arun gasfield near the Sumatran coastal town of Lho Seumawe in 1971, was in the process of drilling 50 development wells, and expects to eventually produce 100,000 barrels per day from the Arun Field. A 1-billion-cubic-foot-per-day LNG plant was being jointly built by Mobil and Pertamina at Arun, for 1977 completion.

At yearend 1976, Indonesia's oil refining capacity stood at 528,000 barrels per day. Three refineries were in the 100,000- to 110,000-barrel-per-day range: Plaju in South Sumatra, Cilacap in Central Java, and Dumai in Central Sumatra. Three other refineries were in the 50,000- to 80,000-barrel-per-day range: Sungei Gerong in South Sumatra, Balikpapan in Kalimantan, and Sungaipakning in Central Sumatra.

[7] U.S. Embassy, Jakarta, Indonesia. Industry Outlook: Indonesia's Petroleum Sector. State Department Airgram A-80, July 1, 1977, 79 pp.

The Mineral Industry of Iran

By Janice L. W. Jolly [1]

The mineral industry of Iran contributed approximately 42% to the 1976 gross national product (GNP) [2] of $54.6 billion[3] at current prices. Petroleum accounted for most of the mineral derived income, but other minerals, while contributing a comparatively lesser amount, nonetheless figured as important in the nation's economic progress. Coal, natural gas, and iron ore production figured significantly in the nation's efforts to develop a steel industry. Cement production could not keep pace with demands of domestic expansion. Iran was also producing nearly 2% of the world's production of lead and zinc and was important as a chromite producer in a world becoming increasingly more conscious of the uniqueness of chromite as a resource. Iranian turquoise and Persian red iron oxides used for pigments are world renowned.

Iran's fifth development plan (1973–78) called for a development investment of $70 billion, of which two-thirds was to come from the public sector. Total Government expenditures of $123 billion in real terms for the duration of the plan were to increase the GNP to $67 billion in 1978, or $1,860 per capita. Over $1.3 billion was to be spent on mining during the plan period. Government income from increasing petroleum exports was expected to finance the development. Industrial exports other than oil were expected to grow at 30% annually. Iran was entering into many joint projects with foreign firms and countries, involving billions of dollars in investments. These included new oil refineries and petrochemical plants, to effect a change from a producer of chiefly raw materials to one of finished products; steel and machine building industries; natural gas development; pipelines; liquefaction projects; and nuclear power projects. Mineral exploration and development was expanding. Recently, however, the strains of rapid growth had caused rising inflation (16% to 18% above that of 1975) and higher demand for skilled manpower. The economic slowdown that occurred throughout the world in 1975 and the resulting dropoff in Iran's oil revenues caused some realistic reappraisal of the speed with which some of the planned projects would be accomplished.

PRODUCTION AND TRADE

The estimated mineral production value for 1976 (based on average world prices) was $422 million excluding petroleum products, clays, and gem stones. Mineral production included cement ($206 million), zinc ($70 million), chromite ($28 million), coal ($27 million), lead ($21 million), iron ore ($20 million), gypsum ($15 million), barite ($3 million), and copper ($2 million). Crude petroleum production for 1976 was valued at approximately $22 billion.

The volume of crude petroleum produced for the year ending December 1976 increased 11% over that of 1975 to an average of 5.9 million barrels per day, but was still below the record production of 1974. Petroleum exports, including refinery

[1] Physical scientist, International Data and Analysis.

[2] All data for Iran calendar year beginning March 21 of year indicated and ending March 20 of following year.

[3] Where necessary, values have been converted from Iranian rials (Rls) to U.S. dollars at the rate of Rls70.62 = US$1.00.

products, for 1976 were valued at $22.8 billion compared with $18.5 billion for the year ending December 1975. Crude petroleum exports accounted for 96% of the total petroleum value exported in 1976. Petroleum exports formed 98% of the total value for all products exported. Record levels of production and exports were reached during the last quarter of 1976 as a result of stockpiling, and during November and December, Iran was producing at its full capacity of 6.7 million barrels per day. Iran had produced a total of 2,168 million barrels of crude oil in 1976.[4]

The Organization of Petroleum Exporting Countries (OPEC) held the price of crude oil at the same level through 1976 as agreed upon in Vienna, Austria, in September 1975. At that meeting, a 10% increase in crude prices was instituted. At the meeting in Bali in May 1976, OPEC failed to agree on a price increase, but at the December 1976 meeting held in Qatar, a 10.34% increase in crude oil prices (effective January 1, 1977) was agreed upon by 11 members. Saudi Arabia and the United Arab Emirates raised their prices 5% and a two-tier price system resulted. The posted price for Iranian crude oil was $12.50 per barrel for 34° API gravity crude and $12.36 per barrel for 31° API gravity crude through most of 1976. In February 1976, however, Iran was obliged to impose a reduction in price (to $11.40) for its heavy crude.[5] Another 5- to 7-cent-per-barrel cut was made in June. One-third or more of Iran's crude oil production was the heavy viscous variety. Demand for heavy crude was particularly slow during the recent worldwide economic slump when factories reduced operations. As a consequence, Iran's petroleum exports were depressed for some months. In an effort to step up its exports, Iran was seeking barter trade deals for oil. In anticipation of a fall in exports for the first quarter 1977, National Iranian Oil Co. (NIOC) was attempting to convince customers to continue to purchase at the high rates. There was a large gap between Arabian Light crude at $12.085 per barrel and Iranian Light crude at $12.81.

Over the past 3 years, Iran's leading suppliers have been the United States, West Germany, Japan, the United Kingdom, and France, in that order.[6] The slight drop in U.S. exports to Iran in 1976 was due in part to the overall contraction of the Iranian market. Similar drops in exports were experienced by Japan and the United Kingdom. On the other hand, West Germany and France reported increased sales to Iran in 1976 compared with those of 1975. Fried. Krupp GmbH, the German steel and engineering corporation in which Iran had acquired a 25.11% share[7] (Iran already owned 25.04% in Krupps steelmaking subsidiary), in 1976 was reported as considering a barter agreement whereby Iran would receive a $135 million copper refinery for 4.5 million tons of crude oil. Iran was also involved in discussions for financing a $3 billion steel complex to be built by Italsider S.p.A., the Italian State corporation, through an oil barter arrangement.[8]

[4] U.S. Embassy, Teheran, Iran. State Department Airgram A–110, July 14, 1977, 38 pp.
[5] New York Times. Iran Cuts Price for Crude Oil Further. June 10, 1976, p. 24.
[6] U.S. Department of Commerce. Commerce America, World Trade Outlook. Jan. 31, 1977, p. 31.
[7] New York Times. Iran To Pay Krupp Over $200 Million for Its 25.01% Stake. Oct. 19, 1976, p. 6.
[8] Financial Times (London). Iran's Demands for Barter. Jan. 13, 1977, p. 16.

Table 1.—Iran: Production of mineral commodities [1] [2]

(Metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
METALS				
Aluminum, primary ingot		49,000	51,000	30,600
Chromium, chromite, gross weight		175,000	210,116	e 160,000
Copper:				
Mine output, metal content		r 650	3,750	e 4,000
Smelter e		r 4,000	r 4,000	4,000
Refined e		7,000	7,000	7,000
Iron and steel:				
Iron ore, gross weight	thousand tons	1,000	1,019	1,100
Pig iron	do	1,500	e 1,000	e 1,000
Steel, crude	do	r 567	551	700
Lead:				
Mine output, metal content		r 25,200	33,600	35,000
Smelter output e		300	300	300
Manganese ore, gross weight		30,000	36,000	40,000
Zinc, mine output, metal content		r 43,268	50,600	72,000
NONMETALS				
Barite		146,000	200,000	230,000
Cement, hydraulic	thousand tons	r 4,500	5,400	e 6,200
Clays:				
Bentonite e		50,000	50,000	50,000
Fire clay		e 31,000	NA	NA
Kaolin		110,000	160,000	e 160,000
Fertilizer materials, manufactured, ammonia		374,000	374,000	NA
Gem stones, turquoise, crude		62	65	e 70
Gypsum	thousand tons	r 3,400	5,000	6,500
Lime e	do	1,000	1,000	1,000
Magnesite		3,000	4,000	5,000
Pigments, mineral, natural		6,000	5,783	6,000
Salt, rock	thousand tons	r 576	691	e 700
Stone, sand and gravel:				
Limestone	do	r 6,000	8,000	e 8,000
Marble	do	r 175	225	320
Silica	do	274	300	300
Travertine	do	200	215	400
Strontium minerals, celestite e		300	300	200
Sulfates, natural:				
Aluminum-potassium sulfate (alum)		51,000	43,000	NA
Sodium sulfate (mineral not specified) e		25,000	25,000	25,000
Sulfur:				
Native e	thousand tons	20	20	20
Byproduct, petroleum and natural gas	do	605	475	399
MINERAL FUELS AND RELATED MATERIALS				
Coal	do	r 900	930	1,000
Coke	do	540	540	e 550
Gas, natural:				
Gross production	million cubic feet	1,766,721	1,603,384	1,776,225
Marketed production	do	787,360	771,057	793,739
Natural gas liquids:				
Propane	thousand 42-gallon barrels	12,760	3,290	3,170
Butane	do	--	3,705	3,673
Natural gasoline and other	do	4,465	5,031	5,283
Total	do	17,225	12,026	12,126
Petroleum:				
Crude (net) [3]	do	2,197,901	1,952,650	2,168,237
Refinery products:				
Gasoline:				
Aviation	do	4,908	4,123	3,166
Motor	do	23,458	26,389	29,474
Jet fuel	do	12,541	12,520	8,857
Kerosine	do	22,051	27,003	32,815
Distillate fuel oil	do	41,175	44,885	49,629
Residual fuel oil	do	97,901	101,243	96,072
Lubricants	do	601	2,495	824
Other:				
Liquefied petroleum gas	do	2,621	3,661	4,184
Naphtha and solvents	do	5,877	8,485	5,289
Asphalt	do	3,752	4,523	5,215
Unspecified	do	2,313	1,048	3,075
Refinery fuel and losses	do	12,811	11,201	16,783
Total	do	230,009	247,576	255,383

e Estimate. p Preliminary. r Revised. NA Not available.

[1] In addition to the commodities listed, other types of crude construction materials (such as common clays, sand, gravel and other varieties of stone) are also produced, but output is unreported and available information is inadequate to make reliable estimates of output levels.

[2] Data are for Iranian calendar years beginning March 21 of that stated, except for natural gas, liquids and petroleum, which are for regular calendar years.

[3] Excludes petroleum produced and reinjected into fields.

Table 2.—Iran: Exports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	18,237	15,587	Japan 13,549.
Arsenic, natural sulfides	18	4	Syria 2; Bahrain 1; India 1.
Chromium, chromite, 48% Cr_2O_3	149,400	77,078	Japan 32,210; East Germany 13,000; Netherlands 10,700.
Copper:			
Ore and concentrate	--	8,700	All to Japan.
Metal including alloys	3	(2)	All to West Germany.
Iron and steel:			
Roasted pyrite	--	220	All to U.S.S.R.
Metal:			
Scrap	166	--	
Pig iron, ferroalloys and similar materials	r 60,319	85	Kuwait 71.
Semimanufactures	1,280	3,600	United Arab Emirates 1,670; Afghanistan 382.
Lead:			
Ore and concentrate	45,813	82,382	U.S.S.R. 67,726; Japan 11,450.
Oxides	(2)	(2)	All to Afghanistan.
Metal including alloys, all forms	921	7	Afghanistan 5.
Nickel metal including alloys:			
Scrap	10	--	
Unwrought	1	--	
Silver metal including waste and sweepings troy ounces	5,787	11,542	All to Libya.
Zinc:			
Ore and concentrate	70,483	63,308	U.S.S.R. 20,996; Poland 13,500; United Kingdom 11,600.
Metal including alloys, all forms	112	--	
Other:			
Ores and concentrates, n.e.s	--	10,200	Japan 9,200; Yugoslavia 1,000.
Metals including alloys, all forms	(2)	--	
NONMETALS			
Abrasives, natural:			
Crude, n.e.s	363	--	
Grinding and polishing wheels and stones	27	5	Saudi Arabia 2; United Arab Emirates 1.
Boric oxide and acid	39	--	
Cement	2,093	1,169	All to United Arab Emirates.
Chalk	27	20	All to Afghanistan.
Clays and clay products:			
Crude clays, n.e.s.:			
Fuller's earth	12	9	Bahrain 7; Oman 1.
Fire clay	10	3	Italy 2; Kuwait 1.
Drilling mud	1,500	10	All to United Kingdom.
Kaolin	--	38	All to France.
Other	6,692	2,258	India 1,101; Kuwait 1,085.
Products:			
Refractory	8	39	Kuwait 38.
Nonrefractory	r 1,446	32	Qatar 13; Japan 6; United States 4.
Cryolite	--	4,000	All to Netherlands.
Diamond value	$34,821	$29,949	All to United States.
Diatomite	--	2	All to West Germany.
Fertilizer materials, manufactured:			
Phosphatic	18	--	
Potassic	35	349	United Arab Emirates 310; Kuwait 39.
Ammonia	135,001	67,195	Republic of South Africa 18,004; Belgium-Luxembourg 17,865.
Graphite, natural	2	180	West Germany 125; Italy 24.
Gypsum	1,477	3,578	Kuwait 3,252.
Lime	--	689	All to Kuwait.
Pigments, mineral, including processed iron oxides	r 204	80	India 56; Kuwait 21.
Precious and semiprecious stones, except diamond value	$769,214	$1,006,609	United States $1,001,555.
Salt	2,059	1,975	Oman 1,172; Kuwait 420.
Sodium and potassium compounds, caustic potash	--	5	All to Kuwait.

See footnotes at end of table.

Table 2.—Iran: Exports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	60,813	19,791	Italy 9,572; Kuwait 7,177; United Arab Emirates 1,936.
Other	140	--	
Worked:			
Slate	992	21	Mainly to Qatar.
Paving and flagstone	972	564	Oman 490; Sweden 74.
Other	2,660	346	Kuwait 177; Qatar 88; United Arab Emirates 51.
Dolomite	297	540	All to Kuwait.
Gravel and crushed stone	52,889	39,065	Kuwait 20,137; United Arab Emirates 18,435.
Limestone (except dimension)	151	--	
Quartz and quartzite	--	(2)	All to U.S.S.R.
Sand, excluding metal bearing	2	3	Kuwait 2; Oman 1.
Sulfur:			
Elemental:			
Colloidal	211,144	43,323	India 19,883; Philippines 10,954; Switzerland 9,392.
Other than colloidal	60,807	84,535	India 59,530; Republic of South Africa 25,000.
Sulfuric acid	15	--	
Talc	--	4	All to U.S.S.R.
Other:			
Crude nonmetals, n.e.s	7,290	4,500	Do.
Slag, dross and similar waste, not metal bearing	12	--	
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural [3]	1,707	2,000	All to Asia.
Carbon black and gas carbon	1	--	
Coal, all grades, including briquets	648	22,245	Italy 21,959.
Coke and semicoke	--	3	All to Afghanistan.
Petroleum: [3]			
Crude and partly refined thousand 42-gallon barrels	1,562,536	1,225,732	Europe 590,989; Asia 350,322; America 157,687.
Refinery products:			
Gasoline ---do---	59,976	53,132	Asia 24,565; Europe 17,347; Africa 4,548.
Kerosine ---do---	13,477	3,661	Asia 1,919; Europe 1,010; Africa 316.
Distillate fuel oil ---do---	66,271	29,401	Europe 11,726; Asia 8,404.
Residual fuel oil ---do---	29,316	5,772	Asia 3,200; Europe 1,303; America 1,012.
Lubricants ---do---	13	16	Asia 15.
Other:			
Liquefied petroleum gas ---do---	8,614	9,797	Asia 9,052; Africa 335.
Mineral jelly and wax ---do---	(2)	(2)	All to Asia.
Bitumen and other residues ---do---	2	31	Do.
Bituminous mixtures ---do---	3	11	Do.
Total ---do---	177,672	101,821	

r Revised.
[1] Data are for Iranian calendar years beginning March 21 of that stated.
[2] Less than ½ unit.
[3] Destinations of shipments reported by continent only.

Table 3.—Iran: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite ore and concentrate	6	20
Oxide and hydroxide	90,456	72,084
Metal including alloys:		
Scrap	15	--
Unwrought	711	5,202
Semimanufactures	13,299	18,465
Arsenic trioxide, pentoxide, acids	90	40
Beryllium metal including alloys, all forms	4	12
Chromium oxide and hydroxide	68	81
Cobalt oxide and hydroxide	21	28
Copper:		
Matte	--	498
Scrap	1,528	2,676
Unwrought	345	635
Semimanufactures	20,670	31,570
Columbium and tantalum metal including alloys, all forms	--	(2)
Gold metal, all forms ---thousand troy ounces--	142	1,041
Iron and steel:		
Ore and concentrate	520	12
Roasted pyrite	--	2,029
Metal:		
Scrap	6,129	7,238
Cast iron	17,193	6,194
Ferroalloys	7,726	7,743
Steel primary forms	208,192	507,396
Semimanufactures ---thousand tons--	2,209	3,020
Lead:		
Oxide	120	1,441
Metal including alloys:		
Scrap	21	12
Unwrought	6,016	602
Semimanufactures	168	532
Magnesium metal including alloys, all forms	59	326
Manganese:		
Ore and concentrate	615	86
Oxide	2,415	2,443
Mercury ---76-pound flasks--	472	785
Molybdenum metal including alloys, all forms	4	2
Nickel metal including alloys:		
Scrap	--	30
Unwrought	63	173
Semimanufactures	r 202	355
Platinum metal including scrap, waste and ash ---value, thousands--	$273	$252
Silver metal including scrap, waste and ash ---thousand troy ounces--	1,031	1,273
Tin:		
Oxide	5	27
Metal including alloys:		
Scrap	(2)	21
Unwrought	453	357
Semimanufactures	260	280
Titanium oxide	1,657	448
Tungsten metal including alloys, all forms	8	16
Uranium and thorium metal including alloys, all forms ---kilograms--	56	--
Zinc:		
Oxides	1,894	892
Metal including alloys:		
Scrap	27	50
Unwrought	2,295	8,071
Semimanufactures	1,718	1,071
Other:		
Ores and concentrates:		
Of molybdenum, tantalum, titanium, vanadium, zirconium	785	1,150
Of base metals, n.e.s	1	3
Ash and residue containing nonferrous metals	50	130
Metals including alloys, all forms:		
Alkali, alkaline earth, rare-earth metals	190	167
Base metals including alloys, all forms, n.e.s	672	332
NONMETALS		
Abrasives, natural:		
Crude, n.e.s	291	152
Dust and powder of precious and semiprecious stones, except diamond	(2)	(2)
Grinding and polishing wheels and stones	1,411	1,220
Asbestos	26,058	24,814
Barite	18	800

See footnotes at end of table.

Table 3.—Iran: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
NONMETALS—Continued			
Boron materials:			
Crude natural borates		--	20
Oxide and acid		54	412
Cement		738,337	1,229,807
Chalk		2,610	4,183
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Fire clay		6,067	9,271
Fuller's earth		1	--
Kaolin		17,034	18,848
Drilling mud		13,159	14,241
Kyanite and sillimanite		1,211	534
Products:			
Refractory (including nonclay bricks)		62,308	48,127
Nonrefractory		3,112	8,417
Cryolite and chiolite		1,034	1,903
Diamond, all grades	value, thousands	$321	$161
Diatomite and other infusorial earth		889	979
Feldspar and fluorspar		641	1,972
Fertilizer materials:			
Crude:			
Phosphatic		212,186	61
Other		r 1,276	2,355
Manufactured:			
Nitrogenous		130,196	177,886
Phosphatic including Thomas slag		47,082	240,421
Potassic		r 7,925	1,988
Other, including mixed		4,036	114,436
Ammonia		62	66
Graphite, natural		1,847	2,522
Gypsum and plasters		983	1,546
Iodine and bromine		288	2,694
Lime		1,489	722
Magnesite		1,898	535
Mica:			
Crude		1,612	2,733
Worked		12	26
Pigments, mineral:			
Natural, crude		9	22
Iron oxides, processed		r 645	515
Precious and semiprecious stones, except diamond:			
Natural	value	$422,848	$283,693
Manufactured	do	$198,314	$196,992
Salt		51	283
Sodium and potassium compounds, n.e.s.:			
Caustic soda		523	6,674
Caustic potash		21	62
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Slate		7	50
Other		--	182
Worked:			
Slate		(2)	35
Other		106	130
Dolomite		136	94
Gravel and crushed stone		1,669	1,083
Limestone (except dimension)		74	253
Quartz and quartzite		1,228	1,228
Sand, excluding metal bearing		10,130	14,333
Sulfur:			
Elemental, all forms		571	422
Sulfuric acid		8,585	68
Sulfur dioxide		17	37
Talc, steatite, soapstone, pyrophyllite		584	192
Other nonmetals, n.e.s.:			
Crude		171	167
Slag, dross, similar waste, not metal bearing		r 4	45
Oxides and hydroxides of magnesium, strontium, barium		808	306
Fluorine, elemental		--	620
Other		446	91
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		123	269
Carbon black and gas carbon		r 8,934	1,975
Coal and coke including briquets		24,501	2,313
Hydrogen and other rare gases		321	558
Peat including peat litter		40	5

See footnotes at end of table.

Table 3.—Iran: Imports of mineral commodities [1]—Continued
(Metric tons unless otherwise specified)

Commodity		1974	1975
MINERAL FUELS AND RELATED MATERIALS—Continued			
Petroleum:			
Crude and partly refined	42-gallon barrels	1,656	151
Refinery products:			
Kerosine and jet fuel	do	(2)	8
Distillate fuel oil	do	239	31
Lubricants	do	70,593	76,026
Mineral jelly and wax	do	33,052	19,060
Other:			
Nonlubricating oils, n.e.s	do	14,749	10,038
Liquefied petroleum gas	do	217	1,160
Pitch	do	21,343	47,960
Pitch coke	do	25,074	6,694
Petroleum coke	do	1,430	264
Bitumen and other residues	do	10,569	9,060
Bituminous mixtures	do	5,218	10,066
Total	do	182,484	180,367
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		30,289	19,671

r Revised.
[1] Data are for Iranian calendar years beginning March 21 of that stated.
[2] Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—The U.S.S.R. reportedly signed an agreement to undertake feasibility studies on recovering alumina from Iran's extensive alunite deposits and possibly constructing an alumina plant using alunite. Iran's alunite deposits were estimated at 1 billion tons, according to the Iranian firm Barite Iran. The Soviet company Tsvetmetpromexport was considering plans for an alumina plant able to produce 500,000 tons annually with provisions to expand later to 1 million tons per year.[9] An investment of $600 million was expected. In addition to alumina, the plant would also be able to produce sulfuric acid and potassium.

Plans for expansion of the Arak aluminum plant had been approved by Iran's Industrial Development and Renovation Organization (IDRO). The first phase of the plant expansion was to be operational by March 1979; capacity was to be gradually increased until March 1981 when it was to reach 125,000 tons aluminum per year. The Arak plant capacity was 45,000 tons per year in 1976. The IDRO was also planning an aluminum beam plant and other industries using aluminum with the expected increased production.

Chromite.—Iran produced approximately 2% of the world's chromite with 210,116 tons of 46% to 48% Cr_2O_3 for the year March 21, 1975, to March 20, 1976. This represented nearly a 20% increase over the 1974 production. Chromite deposits are known to occur in seven areas in Iran, but only four of these, occurring in two belts of serpentinized ultrabasic rocks in northeastern and southern Iran, have been considered economic. The Iranian deposits have been described as a link between the Turkish and Balkan deposits and those of the Logar Valley in Afghanistan and Hindubagh in West Pakistan.[10] The chromite ore bodies formed as typical irregular lenses, pipes, beds, and masses, which pinch and swell, sometimes disappearing at depth and making prediction of reserves difficult.

In the northeast Forumad-Sabzawar District, the Gaft mine was the only operating mine in 1976, but two other small mines (Mirmamoud and Sarur mines) and many small occurrences (Sudkhar, Najmabad, Ziarat, Robatsfid, and Sirsar) were known.[11] The Iran Metals and Mining Co. operated the Gaft mine. Chromite in Iran was first discovered in the Forumad District in 1940. The chromite reserves of

[9] World Mining. Iran. V. 30, No. 1, January 1977, p. 57.
[10] U.S. Embassy, Teheran, Iran. Foreign Service Dispatch 609, Mar. 31, 1959, 30 pp.
[11] Taghizadeh, N., and M.A. Mallakpour. Mineral Distribution Map of Iran. Geological Survey of Iran, Teheran, Iran, 1976.

this district were at one time estimated to be 1 million tons possible and 50,000 tons proved.[12]

In southern Iran, the Khajehiamali mine, located northwest of Neyriz, was a small operating mine in 1976. Somewhat further south and east, in the Esfandaqeh District, the Government-owned Abdasht and Bahborj mines were being operated by the Esfandaqeh Mining Co. of Iran. These mines are located about 60 miles southwest of Sabzavaran. The privately owned (Iran Chromite Co.) Shekhali mine is another small but nonoperating mine in the same area. Chromite deposits known in this area include the Solo, Shah Baqal, Chahdust, and Khash occurrences. Reserves of the Esfandaqeh concession were estimated at 200,000 tons proved, and 1 million tons possible.[13]

The largest producing district is the Fariab District located near Minah. Two large mines were being operated in 1976, the Amir and the Shahriar Shahin, by the Faryab Co. (Shahriar Industrial Group). The Shahriar Shahin mine was estimated to contain two-thirds of the ore in the area of active mines. Some 31 occurrences have been located both in this district and further to the east where several are located just south of the Jaz Murian Depression. The possible resources of this concession have been estimated as high as 50 million tons. More recently, total Iranian chromite reserves at producing mines examined in the year ending March 20, 1976, were estimated at 1,355,000 tons of 40% to 48% Cr_2O_3 proved and 1,850,000 tons probable.[14]

Copper.—Copper ore production at mines inspected by the Ministry of Mines and Industry in the year ending March 20, 1976, was 34,100 tons averaging 4.34% copper. Total mine output was nearly 4,000 tons copper metal. Thirteen operating mines with copper as a major product were indicated on the 1976 mineral distribution map of Iran by the Geological Survey.[15] Two copper mines, the Sunjun and Anjert, were located in a district northeast of Tabrīz and just south of the U.S.S.R. border. The Chizeh copper mine south of Rasht and the Baychebagh copper mine (lead, zinc, copper, molybdenum, bismuth) west of Mianeh have also had small production but were not shown as operating in 1976. The Dorvan (Sanj) mine, which has minor molybdenum minerals, was located just north of Teheran near Karaj. Producing mines east of Teheran included the following: The Chahmesi (minor lead and zinc) located west of Semnān; the Damanjala, Choghonder Sur North, and Choghonder South located west of Sabzevar; and the Taknar (zinc, copper with minor lead, gold and silver) and Dahanehsiah mines located south of Sabzevar. South of Teheran, the operating mine of Veshnoveh was located south of Qom. Also of interest west of Teheran was the Razan (Mazra'eh) copper, lead, and zinc mine which has had small production. In southern Iran, producing mines were located west of Yazd (Mazra'eh-e'Khut) and south of Birjand, where the Qal'eh Zari mine started production in 1975. The Qal'eh Zari was being mined by Minak Co., a Japanese (Toho Zinc Co., Ltd.) and Iranian joint venture. Deposits totaling about 60 million tons of copper and zinc (lead) ore at Chehelkareh near Zahedan were also being explored by Minak. Deposits under development included the Lachar (Meiduk) copper (gold, silver, molybdenum), Chahmesi (Meiduk) copper (zinc, lead), and Chahar Gonabad copper (silver, gold) deposits, all located in the vicinity of Kermān.

Development of Sarcheshmeh was running about 6 months behind schedule, but the initial metallurgical program, which involved only the construction of a smelter, was nearing completion.[16] Startup was expected in late 1977. The mine was controlled by the National Iranian Copper Industries Co. (NICIC) (changed from Sar Cheshmeh Copper Mining Co.), but operational management was under contract to The Anaconda Company of the United States. The Ralph M. Parsons Co. was undertaking design and construction of the processing plant and metallurgical complex. The West German corporation Fried. Krupp and the Mechim Co. of Belgium were expected to start soon on a 135,000-ton-per-year copper refinery.

Gold.—The Muteh gold mine located north of Iṣfahān and just west of Kashan

[12] Haeri, Y. Geology of Iran's Chromite Deposits. Central Treaty Organization, Ankara, Turkey, Symp. on Chrome Ore, September 1960, pp. 21–26.
[13] Work cited in footnote 12.
[14] U.S. Embassy, Teheran, Iran. State Department Airgram A–225, Dec. 29, 1976, 1 p.
[15] Work cited in footnote 11.
[16] Mining Magazine (London). Iranian Copper Mine Progress. V. 136, No. 4, April 1977, pp. 242–243.

was being developed for production by the Iranian Mining and Metal Smelting Co. (IMMSC). Mine operations were suspended in 1972. Reserves were estimated to be sufficient for a 10-year operation at the rate of 770 tons per year.[17]

Iron Ore.—Reserves at the Gol-e-Gowar iron ore deposit were estimated at 400 million tons with 60% iron and a comparatively low phosphate and sulfur content. Construction of the necessary infrastructure for the mine was in the planning stage. The nearest railroad at Zarand was several hundred kilometers north. Commercial exploitation of the deposit was expected to be at least 5 years away.

Total proved reserves of magnetite ore at Choghart were given as 170 million tons.[18] Total resources of iron ore in Iran were estimated to be about 1.2 billion tons.

Iron and Steel.—Of the seven steel projects planned, only three were expected to be producing by 1983.[19] These included the expansion of the Soviet-built Aryamehr steelworks, which is expected to have a total capacity of 1.9 million tons per year by 1983; a new steelmaking complex near Ahwaz, which is expected to have about 2.5 million tons capacity per year; and another steel complex outside Iṣfahān, planned for a capacity of 1 million tons per year. Lagging oil revenues were causing delays in project completions, and many development projects were being reconsidered. The construction of the steel-manufacturing complex near Bandar Abbas was being postponed.

A $40 million contract for three continuous casting machines for use at the Ahwaz steelworks was concluded between the National Iranian Steel Industries Corp. (NISIC) and Nippon Kokan K.K. (NKK) of Japan in 1976.[20] NKK was also to provide technical consultant services for equipment operation and personnel training. Upon completion in 1978, the Ahwaz steelworks was to have 1.5 million tons capacity of crude steel using natural gas and the Thyssen "Purofer" direct reduction process. Two other Japanese companies and Concast A.G. of Switzerland were also involved in the contract.

The direct reduction steel plant of the Shahryar Group at Ahwaz had a rated 400,000-ton yearly capacity with four electric furnaces and a rolling mill. Production was from scrap metal, and the rolling mill produced various structural steels and pipes. The NISIC was doing final studies and a survey on projects for gas-fired smelter complexes in Kangan and Bushire with 3 million tons per year capacity. A total of 10 direct reduction steel mills were planned.[21]

Lead and Zinc.—In 1976, there were 37 operating lead-zinc mines in Iran, 20 of which could be classified as medium to large in size.[22] In northwestern Iran, nine mines were operating: The Senjedeh, Shah Ali Baglu, and the large Angouran mine, west of Rasht; the Barikab and the larger Zehabad mine, west of Qazvin; and the Kalardasht, Pasqal'eh, and the larger mines Duna and Lak, near Teheran. In northeastern Iran, operating mines included those east of Semnān (Reshm and Zereshkuh) and south of Sabzevar (the medium-sized zinc-copper Taknar mine). In central Iran, seven mines were operating near Arak (Babqolleh, Khugan, Ashtian, and the larger Hoseinabad, Lakan, Ahangaran, and Ravandje mines). Also listed as operating were the medium-sized mines Anjireh, Tiran, Vijin, and Shahkuh near Iṣfahān; the Darrehzanjir and Mehrjerd mines near Yazd; and the Siah kuh and Feizabad mines near Ardekan. In east-central Iran, near Anarak, were the Gowd, Nakhaluk, Garmab, Seh changi and Naiband operating mines; and near Bafg were the Ahmadadbad, Kushk, Mehdiabad, Tajkun and Tars mines. There was only one mine operating in southern Iran south of Kermān. This was the Qanat Marvan mine of medium size.

Iran produced nearly 2% of the world's lead with about 35,000 tons of lead metal in 1976. The Ravandje mine, operated by the Société Générale des Minerais (SOGEMIRAN) was the largest lead producer with approximately 10% of the total production. The Ravandje mine also produced barite and zinc. The Angouran zinc-lead mine was the second largest lead producer, operated by the Chekate Shami Calcimen

[17] Mining Magazine (London). Iranian Mine Plans. V. 136, No. 4, April 1977, p. 301.
[18] Iran Chamber of Commerce. Industries and Mines Directory, Teheran. A Glance at Iran. 1975, p. 63.
[19] New York Times. Iran is Apparently Falling Short of Goals for Steel. Mar. 10, 1977, p. 57.
[20] Skillings' Mining Review. Iran Signs Steel Technology Contract With Nippon Kokan. V. 65, No. 40, Oct. 2, 1976, p. 8.
[21] Iran Economic Survey (Teheran). Iron and Steel Production. No. 60, Dec. 2, 1975, p. 5.
[22] Work cited in footnote 11.

Co., but owned by the Société Industrielle et Minière de l'Iran (SIMIRAN). It is primarily a zinc mine. The Nakhaluk lead mine, operated by the Government Iran Mining and Metallurgical Co. (IMMC), produced about 4% of the total lead production. Zinc production was estimated at 72,000 tons metal content in 1976 and was nearly 1% of the world zinc production. The Angouran (18%), Kushk (12%), and Shahkuh (7%) mines were the leading zinc producers. The Kushk mine was operated by the Bafg Mining Co. but was owned by SIMIRAN. The Shahkuh mine was operated by the Bama Mining Co. Estimated reserves at producing mines inspected in the year ending March 20, 1976, were given as 17.2 million tons proved reserves with an average lead content of 6.5% and zinc content of 8.6% and another 26.2 million tons probable reserves.[23] The Sormak Mining Co. operated several small lead (and manganese) mines, including the Ahangaran lead mine, in the Arak area.

Uranium.—Prospecting for uranium was continuing with U.S. and U.S.S.R. assistance. Contracts worth about $300 million for aerial radiometric surveys were made in 1976 with Frankla-Seismis of West Germany, a French company, and Austires of Australia. Areas near Anarak, Yazd, and the Elburz mountains continued to be of interest. From initial surveys in the 1960's joint Iranian-French exploration teams had considered the most promising areas to be the Elburz highland area and the Shemshak and Meygoun mountains.[24] Discoveries near Anarak and near Khawaja-Mared in Khorāsān Province were also of continuing interest. Uranium occurs as a minor element in the copper-nickel deposit at Talmesi north of Anarak.

Two big nuclear reactors were under construction in Iran, with completion expected in 1980. Iran was described as having the fourth largest nuclear development program in the world.[25] Iran has signed and ratified the Nuclear Non-Proliferation Treaty and accepted control by the International Atomic Energy Agency over nuclear installation and material within its sovereignty.

NONMETALS

Barite and Bentonite.—Magcobar Iran, a subsidiary of Dresser Magcobar Corp. of the United States and a joint venture with SIMIRAN, produced barite and bentonite for use in the petroleum industry. Established in 1962, the mines produced 230,000 tons of barite and about 50,000 tons of bentonite in 1976. Barite occurrences in Iran are mostly lode types in Oligocene-Miocene volcanic flows and tuffs.[26] Barite reserves were estimated at 1 million tons proved and 2.9 million tons probable.

Cement.—The volume of cement production reached 6.2 million tons in 1976, and 2 million tons were imported to satisfy domestic consumption. The Ministry of Industry and Mines announced that the production of cement would attain 9 million tons per year by the spring of 1978 and was to reach 19 million tons per year by 1980. An effort was being made to provide for domestic needs by constructing new plants and expanding existing ones. The Gorgan, Māzandarān, Kermānshāh, Behbehan, and Arya (Iṣfahān) cement plants were under construction with part of the Behbehan cement plant ready for use in 1977 and the rest ready for operation in 1978–79. The capacities of the cement factories at Sufian, Abyek, and Teheran were going to be doubled. In all there were plans under study to expand eight factories and to construct seven other plants in Zahedan, Yazd, Kashan, Sanandaj, Hamadan, Bandar Abbas, and Resz'ieh. Expansion of the Sufian cement plant would be completed in 1979 when capacity would be about 5,500 tons per day. Shares in the new factories were to be offered to the public. Fifty-one percent of the new factory shares were to be sold to the public; 12% of the share dividends were to be guaranteed initially for 3 years and thereafter, there would be a 15% guaranteed interest for 7 years.

Gem Stones.—*Turquoise.*—The turquoise mines near Nishapur were believed to be among the most ancient in the world; there were reports of turquoise from this area during the Achaemenid Empire (553–330 B.C.). In the 1940's, mining methods were somewhat modernized adding com-

[23] Work cited in footnote 14.
[24] World Mining. Iran. V. 7, No. 4, April 1971, p. 52.
[25] The Economist (London). Nuclear Man at Bay. V. 262, No. 6968, Mar. 19, 1977, p. 13.
[26] Bariand, P., V. Issakhanian, and M. Sadrzadeh. Primary Metallogenic Map of Iran. Geological Survey of Iran. Rept. No. 7, 1965, p. 18.

pressors and cutting machines, raising the output of the principal mine to 1,000 kilograms of ore per month. There were two small turquoise mines in operation in 1976, which the Government had taken over in 1975. The value of production was estimated to total about $1.3 million. Approximately 70 tons of material was produced. The United States was a principal market for the stone.

Iron Oxide.—IMMC mines red iron oxide for pigment use and export from a deposit on Hormuz Island. Specular hematite iron ore and red ocher occur associated with many of the salt domes in the Persian Gulf region where rocks of the Cambrian Hormuz Series have been thrust up through Cretaceous and Tertiary formations. The ocher deposits located at the south end of Hormuz Island were formed by a process of enrichment during sedimentation in the conglomerates at the base of the Pliocene, and are a reconcentration of original material derived from ancient residual marine concentrations. Production in the year ending in March 20, 1976, was 5,783 tons. Proved reserves were estimated at 66,000 tons with another 165,000 tons probable.[27]

To combat the excessive soluble salt content and high mining costs, IMMC began a new project for upgrading the value of the mineral in 1974. A team of foreign specialists was engaged to implement the project. The new processing plant was to have a capacity of 5,000 tons annually. In the past, normally about 150 men were employed with daily production being about 150 tons. No work was done between July and September because of excessive heat.

Phosphate.—NIOC and the National Petrochemical Co. of Iran (NPCI) were surveying the large phosphate deposits reported as occurring in the foothills of the Elburz mountains near Shemshak, about 40 miles northeast of Teheran.[28] Prospecting of the folded Paleozoic sequence of the Elburz mountains began in 1964[29] when the black phosphate-rich Devonian horizon was originally located 30 miles north of Teheran. Here, the horizon in the Geirud Formation of Devonian age was up to 7.6 meters thick with phosphoritic sandstone containing over 20% P_2O_5 and a fairly consistent association of underlying and overlying beds of phosphatic shale and sandstone with lower (8% to 18%) P_2O_5 content. Prospecting was then extended beyond this region north and east of Teheran. The phosphate rock extends throughout the region and is dark gray with black phosphate pellets. The rock is essentially quartz and apatite with minor clay and some pyrite. The main phosphorite layer in the Elburz mountains was as much as 2 meters thick with values from 20% to 31% P_2O_5. In the area of the original discovery, 24 million tons of high (22.3%) P_2O_5 and 68 million tons of lower (11.4%) P_2O_5 were estimated. At Shemshak, the beds extend for 150 kilometers and are steeply dipping and extensively faulted.[30] Tentative reserves were given as 12 million tons of 22.5% P_2O_5 and 34 million tons of 11.4% P_2O_5.

Another deposit was also recently reported at Zagros. A marine phosphorite deposit at Zagros was initially reported in 1964 by the Iran Geological Survey as occurring in Eocene strata that extended over 500 kilometers along the eastern Zagros range. The phosphate horizon was part of the Pabdeh Formation, a marl and shale sequence on top of the Cretaceous disconformity. The phosphorite horizon was 10 to 40 meters thick in which rich phosphate layers (up to 28.3% P_2O_5) were up to 1 meter thick. The lenticular form of the deposits suggested that these would be uneconomic.

Potassium and Sodium Compounds.—In order to exploit the potassium contained in the brines of various lakes in Iran the brines of Urmiah Lake were investigated as early as 1959. Samples were also examined from Lakes Urmiah (also called Rezaiieh), Neyriz, and Maharlou and from brine springs located in Habib Abad. It was decided to exploit Urmiah Lake. The area of Urmiah Lake comprised 6,000 square kilometers. Its deepest point was 16 meters and it was estimated to contain 60 million tons of K_2O, promising to yield 50,000 tons to 100,000 tons K_2SO_4 yearly in addition to a large amount of sodium

[27] Work cited in footnote 14.
[28] World Mining. Iran. V. 30, No. 2, February 1977, p. 77.
[29] Economic Commission for Asia and the Far East, Bankok, Thailand. Recent Phosphate Discoveries in Iran. 6th Session, Aug. 15–20, 1966, 4 pp.
[30] Mining and Minerals Engineering. Iran Discovers Her Mineral Wealth. V. 1, No. 1, January 1970, p. 19.

chloride. Approximately 25,000 tons of sodium and potassium sulfates are produced yearly in Iran.

Iran's first soda ash plant was commissioned at Shiraz in 1973.[31] The plant was designed to produce 50,000 tons per year of soda ash (sodium carbonate) and 10,000 tons per year of sodium bicarbonate. The plant was designed and constructed with Romanian aid.

Salt.—Iran produced 650,000 to 700,000 tons per year of rock salt derived principally from salt domes located on the Hormuz and Quishm Islands, and from various lake brines. The Hormuz and Quishm Mining Corp., a company owned by IMMC, employed workers on Hormuz Island for mining salt, in addition to red oxide pigment. The salt is mostly used for domestic purposes, but up to 2,500 tons have also been exported yearly to Oman, Bahrain, and Egypt.

Silica Sand.—The main raw material for glassmaking and foundry sands in Iran is quartzite from mines located around Kazvin, Teheran, and Malayer. Kaolin may also be produced as a coproduct from these mines. The Foundry Sand Co., located at Firouzkooh, was a small specialized Government-owned mining operation. The mine here had a production capacity of 35 tons per hour of foundry sand. The mine's output was primarily used by State-owned metalworking complexes Machine Sazi Tabriz and Machine Sazi Arak, both of which are shareholders in the mine. Reserves of refractory sand were estimated at 520,000 tons and silica and quartz at 3.5 million tons in 1975.[32]

Sulfur.—The most workable deposits of sulfur occur in three main regions: (1) At the northern edge of the central desert (Dashte Kavir), (2) in the Persian Gulf area, and (3) inland, 400 to 500 kilometers from the Persian Gulf coast near Shiraz. The northern deposits occur as elemental sulfur disseminated in gypsiferous chalk and soft limestone of Miocene age. The sulfur mineralizations in the Persian Gulf are all related to the numerous salt domes of the area, in various forms as breccia cementing material at the contact of the salt domes and the younger Fars Formation. Some are formed around fumeroles and active sulfur springs. Native amorphous sulfur occurs in the soft friable Fars Formation of calcareous muds and marls near Shiraz. Approximately 20,000 tons of sulfur per year were produced from sulfur deposits. Another 400,000 tons was produced from other sources as a byproduct, principally by recovery operations at the Shahpur and Kharg chemical plants.

MINERAL FUELS

Coal.—Coal has been mined for many years in Iran for local uses, but in 1972, coal and coke production was significantly expanded to supply the new Iṣfahān steel mill, which began production in 1973. In 1975, the State-owned National Mining and Smelter Co., IMMC, and NISIC were all operating coal mines. Coal production was expected to reach 8 million tons per year by 1980. NISIC was the largest single producer of coal with collieries in Kermān, Elburz, Sanghroud, and Shahroud. IMMC was operating mines or was exploring for coal in areas east of Mashhad, north of Kermān, and north and northeast of Teheran. Coal washing facilities were operated near Zarand near Kermān and at Shahroud. Development of the Elburz, Shahroud, and Kermān coal deposits were a key objective in the fifth development plan.

Of the more than 30 coal deposits in Iran, which were estimated[33] to contain a possible 1.8 trillion tons (of which only a part are exploitable), the Kermān Province deposit has been the most thoroughly studied and has proved a good source of coking coal. Divided into five coal zones (classified as A, B, C, D, and E zones) of Lower to Middle Jurassic age, the Kermān deposits under development or producing were collectively estimated at greater than 380 million tons. The producing area of Shahroud in Semnān Province was estimated to have 150 million to 160 million tons. Major producing mines in Semnān Province included the Damghan mines and the Kalavi, Tarz, and Dehmolia deposits at Shahroud. Producers also included the Sanghroud mine in Gīlān Province and the IMMC Golbanu and Chesmegol mines east of Machhad in Khorāsān. In January 1975,

[31] Industrial Minerals (London). Iran. No. 70, July 1973, p. 39.

[32] Iran Economic Service (Teheran). Mining Development in Iran. IES News, No. 63, Dec. 23, 1975, p. 10.

[33] Glazov, I. National Iranian Steel Co., V/O "Technoexport" U.S.S.R., Brief Information About the Kermān Coal Deposit. Unpublished report, February 1968, 7 pp.

discovery of large coal deposits estimated to consist of about 200 million tons were announced in the northeast, between Gonbad-Kabus and Shah Pasand (Mazandaran) and Bojnurd (Khorāsān).

Producing areas in the Kermān Province included Pabdana (68 million tons estimated reserves) and Badamu (20 million tons estimated reserves). Four new deposits were also under development in Kermān: The Darbidkun (50 million to 200 million tons reserves), Khamrud (40 million tons reserves), Sarapardeh (36 million tons reserves), and Assadabad (15 million tons reserves). The best coking coal occurs in the D (Dogger) zone of Middle Jurassic age in the Kermān deposits. Carbonizing properties of five coal samples were determined [34] from three zones within the Kermān deposit. Two samples ranked as medium-volatile bituminous coal and three as high-volatile bituminous coal. The ash content of all five samples was high, ranging from 9.6% to 26.2%. The sulfur content ranged from 1.0% to 4.1%, of which 76% was pyrite. The phosphorus content ranged from 0.007% to 0.031%. Compared with U.S. coals, the coke, tar, and light oil yields were lower and the gas yields (percentage basis) higher for the Iranian coal. The heating values of the gases from Iranian coals were lower than those of U.S. coals of similar rank. The coals of the Lower Jurassic (Lias) A, B, and C zones in the Kermān area were more highly metamorphosed and thus generally unsuitable for coking.[35] The Kermān deposits have complex geologic structure.

The Lower Jurassic (Lias) beds of the Elburz mountains also contain a variable quantity of coal seams intercalated with a thick series of shales and sandstones.[36] The Lias coal horizon in this area has been easy to mine where the beds outcrop along escarpments formed along the edges of synclinal basins. Within the basins themselves, however, commercial recovery of the large quantity of coal that is presumed to occur buried would be doubtful because of the deep mines that would be required.

In 1975, the coke plant at Iṣfahān used 770,000 tons of coal per year and produced 44,000 tons of metallurgical coke, 30,000 tons of coal tar, 4,700 tons of sulfuric acid, 4,500 tons of benzol, and 5,600 tons of aluminum sulfate.[37]

Natural Gas.—The natural gas share of local energy consumption in Iran was expected to reach 35% by 1987 from the 18% to 24% expected at the end of the fifth development plan in 1978. Iran was already conscious of the role it was to assume in the future as a principal gas provider to western Europe as evident in a paper presented by the National Iranian Gas Co. (NIGC) to the 13th World Gas Conference in 1976.[38] Iran's proved natural gas reserves were given as over 11,000 billion cubic meters by NIGC. NIOC had also confirmed in June 1976 the discovery of large natural gasfields near Bushehr, about 500 miles south of Teheran in the Persian Gulf. The field was being developed by a consortium of Iranian, Japanese, U.S. and Norwegian companies but was discovered several years ago by a joint Shell/Iranian venture. Shell pulled out and the consortium took over the company.[39] Several gasfields also have been discovered in cooperation with the European Group of Oil Co. (EGOCO) in the Kangan area. Companies in the EGOCO venture with NIOC include Entreprise de Recherches et d'Activités Pétrolières (ERAP), French, 32%; AGIP S.p.A., Italian, 28%; Hispanoil, Spanish, 20%; Petrofina Française, French, 15%; and Öesterreichische Mineralöelverwaltung AG (ÖEMV), Austrian, 5%.

Assuming completion of current projects, Iran was expected to have an export capacity of about 67 million cubic meters of gas per year by the mid-1980's. Iran had the second largest proved gas reserves in the world after the U.S.S.R. By yearend 1976, Czechoslovakia had signed an agreement joining West Germany, France, Austria, and the U.S.S.R. for Iranian natural gas to be delivered by the second Iranian gas trunkline (IGAT-II). IGAT-II pipeline was to be completed for scheduled deliveries to begin in 1981. Approximately 17 billion cubic meters per year were to

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[34] Behre Dolbear and Co. Report of tests made on Iranian coals. Unpublished U.S. Bureau of Mines report, Contract No. 14-09-050-1876, Jan. 19, 1959, 11 pp.; available for consultation at U.S. Bureau of Mines, Washington, D.C.

[35] Work cited in footnote 33.

[36] White, E.J., F.C. Slinger, S. Elder, and J.H. Esslinger. Elburz Coal Survey. Interim Report on the Initial Stratigraphic Reconnaissance. July–November 1939. Anglo-Iranian Oil Co., Ltd., March 1940, 73 pp.

[37] Work cited in footnote 21.

[38] Petroleum Economist (London). Future for Natural Gas Trade. V. 43, No. 7, July 1976, p. 250.

[39] New York Times. Iran Confirms Gas Discovery. June 17, 1976, p. 11.

be delivered to these countries with a 3-year buildup. Local needs of about 10 billion cubic meters per year of gas were also to be transmitted by IGAT-II with an 8-year scheduled buildup. The cost of the IGAT-II pipeline project was estimated at $2.5 billion. Snam Progetti S.p.A. (Italy) and Sofregaz, a subsidiary of Gaz de France (France), were awarded the contract for detailed design and engineering for the 1,420-kilometer pipeline that was to extend from Shiraz and Iṣfahān in southern Iran to Astara on the Soviet frontier. NIGC was studying tenders for contracts for material procurement and handling, supervision and inspection, project management and construction.[40]

NIOC was planning construction of seven new plants (in addition to the six already in operation) which were to process a total of 4.7 billion cubic feet of natural gas per day. When completed these plants and additional facilities were to allow meeting the needs of the Iranian gas trunkline (IGAT) and the Iran, Japan Petrochemical Co. (IJPC) and NIOC natural gas liquids (NGL) refinery at Bandar Mah Shahr. In 1976, these needs were being met by the following plants: NGL 100, 200, and 300 at Agha Jari; NGL 400 and 500 at Marun; and NGL 600 at Ahwaz. Engineering design studies were nearly complete on the plants that were to be situated at Ahwaz (NGL 700 and 800) which were expected to be commissioned in the first half 1979. Plants NGL 900 and NGL 1000 in the Pazanan Field will process gas for injection into Gachsaran and Marun Fields. Site preparation was nearly complete for both plants. NGL 900 was to be commissioned in early 1978 and NGL 1000 was to be commissioned in early 1979. Both were to have a processing capacity of 1.5 billion cubic feet of gas and 45,000 barrels of liquids per day. Preliminary design work was being done for NGL plants 1200 (at Gachsaran), 1300 (at Bibi Hakimeh) and 1500 (at Karanj).[41]

An Italian consortium signed a contract with NIGC for the construction of a gas plant, which was expected to employ 1,000 workers including 30 Italians at Sarakhs. The Pars liquefied natural gas (LNG) project was reportedly canceled. Feasibility studies had shown that liquefaction facilities would have cost considerably more than earlier anticipated without corresponding increases in the value of gas in western markets. A Spanish company bought two-thirds of the 15% share held by International Systems and Controls in the Kangan Liquefied Gas Co. (Kalingas) LNG export project, in which Peoples Gas, Light & Coke Company of Chicago was taking over two-thirds of Chicago Bridge and Iran's 7.5% share inthe same venture.[42]

The Oil Service Co. of Iran (OSCO) was engaged in the implementation of a major gas-injection program in the Khūzestān area. Initial stages of this project were underway in the Asmari reservoir at Haft Kel. Gas for the project, some 400 million cubic feet per day, was to come from six wells in the Naft Safid Field through a new 24-inch line. Drilling of four injection wells at Haft Kel and construction of pipelines and gas-treating facilities was underway. Later the 24-inch line was to be extended to Paris Field where another injection project using Naft Safid gas was to begin in 1978. The Haft Kel project was regarded as a pilot scheme for similar injection programs in larger fields such as Gachsaran, Karanj, and Marun. It was estimated that the complete Khūzestān injection project would need 13 billion cubic feet per day of gas. Cost of the overall gas injection program was put at $2.5 billion.[43]

Petroleum.—*Exploration.*—Iran, through NIOC, has contractual agreements with a number of international companies. Agreements made under the 1974 contractual formula require payment of a cash bonus and spending of an agreed sum for exploration over a 5-year period. In event of commercial discovery, NIOC was to take over production and development operations. NIOC was to sell about 50% of the production to the exploration company at a discount of about 5% off market price, depending upon the agreement. An amount was allotted for exploration and development compensation, but no compensation was paid if no commercial property was discovered.

A 3-year agreement for joint research into oil exploration, production, and im-

[40] Petroleum Economist (London). Iran. V. 43, No. 7, July 1976, p. 282.
[41] Iran Oil Journal (Teheran). Giant Gas Projects Largest in History. No. 191, Autumn 1976 and Winter 1977, pp. 22–23, 30.
[42] Petroleum Economist (London). Iran. V. 43, No. 11, November 1976, p. 442.
[43] Oil and Gas Journal. NIOC Shapes Iran's Exploration, Production. V. 74, No. 33, Aug. 16, 1976, p. 88.

proved recovery techniques was signed between NIOC and Shell Oil Iran.[44] Elf Iran has made two discoveries, one with Sofiran (a company involving the French State oil company, ERAP). Elf's offshore Sirri Field was expected to produce 150,000 barrels per day during 1977. Deminex, Total Iran, Ultramar Iran Oil Co., AGIP Iran, Hormog Petroleum Co. (Hopeco), Phillips Petroleum Company Iran, and Bushehr Petroleum Co. (Bushco) have all been operating under contract with NIOC. Exploration activity was highlighted by the following: Bushco was drilling offshore near Bushire; Hopeco was exploring offshore near Bandar Abbas, and Phillips, in the west district near Bandar Abbas; AGIP Iran was drilling onshore in the Lar area; Sofiran-EGOCO was continuing to drill in the Aghar-Khaura Districts; and Ultramar was exploring for oil near Bandar Lengeh and Deminex Iran in the Sabzpooshan Field near Shiraz.[45]

OSCO had 41 rigs in the field during 1976 drilling 125 wells including 14 exploration wells. The deepest hole drilled in southern Iran was the Agha-Jari No. 140 well which was 18,342 feet.

Production.—Crude petroleum production by the Société Irano Italienne de Pétroles (SIRIP), an AGIP Mineraria (50%) joint venture with NIOC, was about 16.6 million barrels in 1976. SIRIP held three producing petroleum concession blocks on the continental shelf of the Persian Gulf and three commercial blocks in a mainland area on the eastern slopes of central Zagros Mountains that were under development with production expected to begin in 1978. SIRIP was also undertaking major expansion of processing facilities.

Iran Pan American Oil Co. (IPAC) (Amoco Iran Oil Co. 50%, NIOC 50%) operated four oilfields in the Persian Gulf and produced 108 million barrels of crude in 1976. Darius Field produced at a rate of 100,000 barrels per day; Cyrus Field averaged 45,000 barrels per day; Fereidoon Field development was to eventually bring peak output to 150,000 barrels per day; and the Ardeshir Field was expected to reach full capacity at 200,000 barrels per day in 1978.

The Lavan Petroleum Co. (LAPCO) (Atlantic Richfield Co. 12½%, Murphy Oil Corp. 12½%, Sun Oil Co. 12½%, and Union Oil Co. 12½%) and NIOC joint venture held two commercial fields. In 1976, the LAPCO Sassan Field produced 55.7 million barrels. The Bahram Field was scheduled to start production in 1977 at about 45,000 barrels per day.

The Iranian Marine International Co. (IMINOCO), a 50–50 venture with NIOC that includes Phillips Petroleum (16⅔%), AGIP (16⅔%), and the Oil and Natural Gas Commission of India (16⅔%), produced 17.3 million barrels from the Rostam and Rakhsh Fields. Both fields need stimulation and a water injection project under way for Rakhsh Field was expected to boost capacity from about 35,000 barrels per day to 90,000 barrels per day. A third field, Alpha, was being evaluated.

Consortium members which now purchase most of Iran's oil are formally linked in a joint, London-based corporation, Iran Oil Participants Ltd., and they take Iranian oil in proportion to their equity in the group. The Royal Dutch/Shell Group accounts for 14%; Compagnie Française des Pétroles accounts for 6%; five major American oil producers—Exxon Corp., Standard Oil Co. of California, Mobil Oil Corp., Texaco, Inc., and Gulf Oil Corp.—account for 7% each; and British Petroleum Co. (BP) accounts for most of the rest. Various services are provided by the consortium in Iran under contract between NIOC and the consortium-owned concern, OSCO, which carries out production and exploration and other technical services in the southern areas where the consortium buys petroleum. Negotiations for a revision of the 1973 agreement under which the consortium buys most of Iran's oil was in progress. Approximately 5.4 million barrels per day came from the former Consortium Khūzestān Fields in 1976. The NIOC Naft-e-Shah produced a total of 6.7 million barrels for 1976.

NIOC completed a $60 million project to expand the loading capacity of the Azarpad steel jetty near Kharg Island in the Persian Gulf in early 1976. With the project completion, the loading capacity of the oil terminal has been doubled. Tankers of 500,000 and 300,000 tons each can be served at a time. It is possible to deliver 46,000 tons of crude oil per hour through

[44] Work cited in footnote 40.
[45] Oil and Gas Journal. NIOC Shapes Iran's Exploration, Production. V. 74, No. 33, Aug. 16, 1976, p. 93.

the pipes laid between the Kharg Island tank farm and the jetty.

Refineries.—Iran was predicting a need for a 100,000-barrel-per-day refinery every 2 years over the next 10 years to meet its expanding petroleum demand. By 1980, about $3 billion was expected to be invested in new refining facilities. Current refining capacity was about 736,000 barrels per day and was expected to reach about 981,000 barrels per day in 1977.

Work was progressing on the new refinery at Tabrīz where construction was started on June 12, 1975. It will have a capacity of 80,000 barrels per day or 4 million tons annually and is scheduled to start up in April 1977. It will have 14 interconnecting refining units. When completed, the northeastern province of Azarbaijan will almost cease to depend on products currently being supplied from Teheran refineries. The Tabrīz refinery will produce liquefied petroleum gas (LPG), gasoline, kerosine, gas oil, fuel oil, and asphalt. Before construction, a 380-mile pipeline was built from Teheran to Tabrīz. This line will be used to carry crude for the refinery with an ultimate throughput of 87,000 barrels per day.

Preliminary engineering and economic feasibility studies for the Iṣfahān refinery were completed by NIOC engineers, and a ground-breaking ceremony took place in December 1976.[46] The refinery was to have a capacity of 200,000 barrels per day, and was to be constructed by the Fluor Thyssen Joint Venture Co. It will consist of two independent plants, each with 100,000-barrel-per-day capacity. The first plant was scheduled for operation in early 1978 with the second following later in the year.

A new refinery to be situated close to the Ahwaz Fields with a 350,000-barrel-per-day capacity was in the preliminary design stage. Scheduled for startup by 1979, it was to produce both petroleum products and feedstock for adjacent petrochemical plants. Doubling the Shiraz refinery by 1978 was also under study. Now rated at 40,000 barrels per day, it was designed for maximum production of middle distillate. Debottlenecking of the Teheran refineries was also to be undertaken to raise capacity from 200,000 barrels per day to 225,000 barrels per day. At Lavan Island, a multipurpose topping plant was completed in 1976. The capacity of the Abadan Refinery was being boosted from 460,000 barrels per day to 600,000 barrels per day. A new 24-inch pipeline was to be laid from Ahwaz to Abadan to supply additional crude. The construction was expected to be complete by early 1977.

Iran was to enter into several joint petroleum refinery agreements during 1976. An agreement was concluded between Iran and Japan in November 1976 for building a new oil refinery in southern Iran. It was to be completed by 1983 and was initiated to meet growing Japanese petroleum product demands. In a joint venture arrangement with Senegal, the Iran-Senegal Petroleum Co. was also established to build and operate a 60,000-barrel-per-day refinery on a 50–50 partnership. A ground-breaking ceremony took place in November 1976 near Ounsan city in South Korea for the joint Iranian-Korean oil refinery. The 50–50 equity shares were to be owned by NIOC and Sang-Ung Oil Co. of South Korea.

Petrochemicals.—Five petrochemical development centers have been developed in the last 10 years at Abadan, Bandar Shahpur, Ahwaz, Kharg Island, and Shiraz. All are controlled by the National Petrochemical Co. of Iran (NPCI), a subsidiary of NIOC. The five areas produce over 800,000 tons per year of ammonia products, phosphatic and compound fertilizers, soda ash, and nitric acid. They also produce about 600,000 tons per year of sulfur, 60,000 tons per year of polyvinyl chloride, 12,000 tons per year of detergent alkylate, 16,000 tons per year of carbon black, and 30,000 tons per year of sodium tripolyphosphate. Plant expansions and construction in progress were to double the production capacity so that by mid-1979 or early 1980, $3 billion worth of new facilities would have been commissioned. Iran was expected to invest $1 billion annually in petrochemical development over the next 5 years.

A 50,000-ton-per-year mixed fertilizer unit and a 30,000-ton-per-year sodium tripolyphosphate unit were commissioned at the Iran Fertilizer Co. complex near Shiraz (wholly owned by NPCI), and a major expansion program was to add capacity for 1,200 tons per day of ammonia, 1,500 tons per day of urea, 750 tons per day

[46] Iran Oil Journal (Teheran). Construction of Iṣfahān Refinery. No. 191, Autumn 1976 and Winter 1977, pp. 2–3, 14.

of 30% ammonium nitrate, and 600 tons per day of nitric acid. The expansion would be complete in first half 1977. Further expansion to bring the polyvinyl chloride production to 120,000 tons per year at Abadan Petrochemical Co., Ltd.'s plant was under study. Expansion of Shahpur Chemical Co., Ltd.'s complex would add a capacity of 330,000 tons per year of ammonia, 465,000 tons per year of urea, 198,000 tons per year of monammonium phosphate, and 627,000 tons per year of sulfuric acid. It was planned to double the output of the Kharg Chemical Co., Ltd., a 50–50 venture between NPCI and Amoco. It currently recovers some 230,000 tons per year of sulfur and 300,000 tons per year of LPG from gas in offshore fields in the Gulf and from Kharg Island onshore production.

A second phase expansion at the Iran-Nippon Petrochemical Co., Ltd. (NPCI 50%, and Nissho Iwai Company Ltd. and Mitsubishi Chemical Industries Limited, 25% each) plant was to be for production of 2-ethylhexano as raw material for dioctyl phthalate. The first phase of the project was to come onstream in late 1976 or early 1977 and involved production of 23,800 tons per year of phthalic anhydride and 40,000 tons of dioctyl phthalate.

The largest project was the $1.8 billion petrochemical plant that was to start construction at Bandar Shahpur under a 50–50 joint venture agreement between NPCI and the Iran Chemical Development Co. (owned by five Japanese firms headed by Mitsui & Co. Ltd.). Completion was scheduled for early 1980 of the major olefin aromatic complex with three core units—olefins, aromatic and chlor-alkali—feeding 10 satellite processes.

The Mineral Industry of Iraq

By David E. Morse [1]

The mineral industry of Iraq continued to be dominated by the petroleum sector during 1976. Revenue from crude oil was the keystone of the country's economy. Oil revenue was used to balance the budget, to stabilize the currency, to maintain a positive trade balance, and to provide the funding for industrial and agricultural development projects.

Iraq was one of the major producers and exporters of oil in the Middle East, and was an active member of the Organization of Arab Petroleum Exporting Countries (OAPEC) and the Organization of Petroleum Exporting Countries (OPEC). OPEC price increases for petroleum have raised Iraq's gross national product (GNP) from $5.3 billion [2] in 1973 to an estimated $16 billion in 1976. Output from the oil sector, entirely Government owned, constituted about 60% of the GNP during the year.

In September, the Government issued Law No. 101 of 1976 organizing the Ministry of Oil, defining the Ministry's divisions and powers, and providing the general rules pertaining to the Ministry. Implementation of the new law began in mid-October when the Oil Minister reorganized the oil industry. Subordinate to the Ministry were the foreign relations and investment office, the collection planning department, the project studies department, and Iraq Petroleum Co. Ltd. Iraq Petroleum included four boards: The State Board for Marketing and Transporting Oil and Oil Products, the State Board for Prospecting and Drilling Oil and Gas Wells, the State Board for Extracting Oil and Gas in the Northern Region (to replace the Iraqi Company for Oil Operations), and the State Board for Extracting Oil and Gas in the Southern Region (to replace Iraq National Oil Company). Iraq Petroleum also had four components specializing in prospecting for oil and gas, drilling for oil and gas, marketing oil and oil products, and operating Iraqi oil tankers.

The new 5-year development plan (1976–80) was delayed, and the Government began reviewing the plan in April, placing a "hold" on most major development projects. Prior to review, the development plan was to commit $33.8 billion to economic development, with emphasis on the industrial and agricultural sectors. Revision was to be announced in early 1977, with a shift in priority to housing, education, transportation, and communications at the expense of industrial projects.

Iraq embarked on several civil engineering projects to increase and improve port facilities near the Persian Gulf, to control flooding of the Tigris and Euphrates Rivers, and to provide water for irrigation projects.

The Government awarded a $400 million contract to the Japanese Mitsubishi group for construction of a thermal powerplant near Al Qurnah, about 20 kilometers north of Basrah. The plant, to provide power to the Basrah area, is to have four 200-megawatt generators and be onstream in 1980. Hidrokradina of Yugoslavia received a $186 million contract to build a flood-control dam and hydroelectric complex on the Diyālá River east of Baghdad. The project is to be completed in 1981 and have two 40-megawatt hydroelectric stations. The Government planned to build a hydroelectric dam on the Tigris near

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Iraqi dinars (ID) to U.S. dollars at the rate of ID1=US$3.3778.

Mosul in the north with an eventual output of 600 megawatts.

In February 1976, Iraq and Saudi Arabia signed a final agreement for the demarcation of their border in the neutral zone. An interim agreement had been signed in 1975, and Pacific Aero Survey Co., Ltd., of Japan was hired to survey the border and provide detailed maps.

PRODUCTION

During 1976, crude oil production increased 1.7% to 112 million tons from 110.1 million tons in 1975. Total crude oil output for the year averaged slightly over 2.1 million barrels per day, but there were large monthly variations. January's output was about 1.9 million barrels per day. The yearly low of 1.44 million barrels per day in April was followed by a recovery to 2.4 million barrels per day in August and a record high monthly output of slightly over 3 million barrels per day in December. The variations in output had several causes. The loss of markets after Iraq nationalized Basrah Petroleum Co. Ltd. in December 1975 and the suspension of Mediterranean oil deliveries from the Kirkuk pipeline to Syria and Lebanon produced the early slump. Transport of Kirkuk oil through the newly completed (1975) strategic oil pipeline to Persian Gulf ports, expanded production capacity, and reestablishment of markets were responsible for the recovery and record output.

During the year, cement output remained stable at about 2.4 million tons, and sulfur production increased from 640,000 tons in 1975 to 675,000 tons in 1976. A small amount of phosphate rock was mined from the Akashat deposits near the Syrian border for chemical and physical testing.

Table 1.—Iraq: Production of mineral commodities

Commodity [1]		1974	1975	1976 [p]
Cement, hydraulic	thousand metric tons	[r e] 2,300	2,385	[e] 2,400
Gas, natural:				
Gross production	million cubic feet	329,237	368,648	468,553
Marketed [2]	do	41,989	58,410	74,408
Gypsum	thousand metric tons	[e] 150	156	[e] 160
Natural gas liquids:				
Natural gasoline	thousand 42-gallon barrels	[e] 925	955	[e] 960
Propane and butane [3]	do	[e] 2,200	2,249	[e] 2,300
Petroleum:				
Crude	do	[r] 719,269	825,521	881,621
Refinery products:				
Gasoline	do	4,412	4,501	5,549
Jet fuel	do	1,175	1,199	1,341
Kerosine	do	4,118	4,200	3,490
Distillate fuel oil	do	7,973	8,030	8,432
Residual fuel oil	do	5,278	5,383	8,568
Lubricants	do	353	360	372
Other	do	9,256	9,441	7,360
Refinery fuel and losses	do	2,017	2,057	2,130
Total	do	34,582	35,171	37,242
Salt [e]	thousand metric tons	60	60	70
Sulfur, elemental:				
Native, Frasch	do	610	600	610
Byproduct [e]	do	[r] 50	[r] 40	65

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the commodities listed, lime and a variety of crude construction materials (clays, stone, and sand and gravel) are produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2] Includes reinjected, if any.

[3] Includes small quantities of propane and butane from refineries.

TRADE

During 1976, crude oil exports accounted for the bulk of Iraq's mineral exports. Petroleum exports were valued at $8,600 million, a 4% increase over that of 1975, representing about 97% of the total value of Iraqi exports. Petroleum exports decreased about 3.6% in quantity during the year, but Iraq received a price increase of nearly 7% per barrel. Sulfur was also an important mineral export, with large quantities shipped to India, the People's Republic of China, Tunisia, and Egypt. In January 1976, Iraq and Czechoslovakia signed a new trade exchange pact to provide Iraq with Czechoslovak products and to increase Iraqi exports of sulfur and other commodities.

The latest data available on trade is that for 1974, reported in the 1975 edition of this chapter.

COMMODITY REVIEW

METALS

Aluminum.—The 30,000-ton-per-year aluminum plant at An Nāṣirīyah, on the Al Furat River about 170 kilometers northwest of Basrah, was under construction in 1976. The plant is to process imported alumina and be in full operation in 1977.

Iron and Steel.—Creusot-Loire was constructing a $120 million iron and steel complex on Khor al Zubair near Umm Qaṣr south of Basrah. The plant is to have a 1.2-million-ton-per-year sponge iron output and auxiliary iron and steel facilities to produce steel beams, rods, pipes, and sheets.

NONMETALS

Cement.—During 1976, Iraq's installed cement plant capacity was about 3 million tons per year. Production was about 2.4 million tons during the year. Expansion of existing plants and construction of new plants continued, with total capacity to reach 7.2 million tons per year by 1978 and 9 million tons per year by 1980. The status of the 500,000-ton-per-year expansion of the Al-Samawa cement plant by a Soviet firm was not known, but completion had been expected in 1976. Construction was underway on a 2-million-ton-per-year plant at Al Kūfah, a 500,000-ton-per-year plant at Ḥammām al 'Alīl, and a 500,000-ton-per-year plant at El Mathna.

The Government and an unnamed foreign firm signed an $18 million contract for construction of a plant to produce concrete railroad ties. The plant was to be built at Baghdad and produce 500,000 reinforced concrete ties per year.

Fertilizer Materials.—*Nitrogen.*—The first stage of expansion of the Basrah chemical complex in southeastern Iraq was tested in September and came online in December, adding 200,000 tons per year of ammonia and 325,000 tons per year of urea to the existing capacity of 84,000 tons and 52,000 tons per year, respectively. The second stage of expansion was underway and was to add 500,000 tons per year of ammonia and 825,000 tons per year of urea when completed in late 1979. An 800,000-ton-per-year urea plant was under construction at Az Zubayr, about 15 kilometers south of Basrah. The plants were to use associated natural gas from the southern Rumaila oilfield as feedstock.

Phosphorus.—Iraq has taken the first steps in establishing a domestic phosphate industry. A $635 million contract was signed with Syndicate Belge d'Entreprises a l'Etranger (Sybetra) of Belgium in association with Union Minière S.A. of France to establish a phosphate mine at Akashat in western Iraq near the Syrian border and a phosphate beneficiation facility and fertilizer complex at Al Qā'im on the Euphrates River, 12 kilometers from the Syrian border. The Akashat mine is to produce 3.4 million tons per year of phosphate rock averaging 21% P_2O_5. Crude ore is to be shipped to Al Qā'im where water from the Euphrates is available for the beneficiation plant and fertilizer complex. The Industrial Equipment Div. of F.L. Smidth & Co. A/S of Denmark is to build the $50 million beneficiation plant. The components of the projected plant are 12 railroad discharge silos with two extraction feeders each; a circular 80,000-ton homogenization silo; a screening and

crushing plant with four vibrating screens and two crushers for crushing to 16 millimeters; a circular 28,000-ton silo for 16-millimeter crushed ore; two rotary kilns, 130 meters long, provided with planetary coolers and dedusting scrubbers; a slaking plant for dry slaking of calcined phosphate; two parallel washing lines, each containing a 1,600-kilowatt grinding mill and a centrifugal dewatering section; a thickener for wastes; and transport and storage facilities for the beneficiated product. The fertilizer complex is to have a 4,500-ton-per-day Parsons-process sulfuric acid plant that will use domestic sulfur. The sulfuric acid will be used to process Akashat phosphate rock to produce 400,000 tons per year of phosphoric acid (P_2O_5) for the production of granular triple superphosphate (600,000 tons per year), monoammonium phosphate (250,000 tons per year), and a variety of complex fertilizers (272,000 tons per year). Total fertilizer output is to be 1.1 million tons per year, and the project is to be operational in early 1980. In March 1976, the Government established General Phosphate Co. to manage the new Iraqi phosphate industry.

Stone.—*Marble.*—Iraq and an Italian firm were to develop facilities for production of block marble at Sulaymānīyah, southeast of Kirkuk, and Niawa, south of Mosul. The details of the projects were not publicized.

Sulfur.—The larger share of Iraq's 1976 sulfur production came from Misraq State Sulfur Co.'s operation, south of Mosul in north-central Iraq. Production came from a cavernous, bedded deposit, estimated to contain over 200 million tons of sulfur. Extraction was accomplished using a Polish modification of the Frasch process, and output for 1976 was about 610,000 tons. Sulfur was also produced at the natural gas processing plant at Kirkuk. Reliable figures on the 1976 output from Kirkuk were not available but were estimated at about 65,000 tons.

MINERAL FUELS

Natural Gas.—At the beginning of 1976, Iraq's proven reserves of natural gas were estimated at 27 trillion cubic feet. Iraq initiated studies to make greater use of the associated natural gas from crude oil production that has been mostly flared. Procon (Great Britain) Limited and two U.S. companies began a study on production and utilization of natural gas from central and northern fields. Natural gas from the Rumaila Field in the south was to be used as feedstock for fertilizer plants and as a source of energy for electric powerplants.

Petroleum.—The Government reported crude oil reserves in Iraq at 75 billion barrels, although industry sources estimated reserves at 34.3 billion barrels. Iraq's petroleum industry was actively engaged in exploration and development projects and in construction of pipelines and export facilities. An estimated 27 rigs were drilling for oil in Iraq during 1976, about one-third owned by the Government and the remainder by foreign companies.

New production wells at the Kirkuk oilfield complex, which included the Bāi Hassan and Jamba Fields in northeastern Iraq, expanded the capacity of the complex from 1.2 million barrels to 1.4 million barrels per day at a cost of $85 million. An additional $100 million was to be spent to increase the output of the Bāi Hassan and Jamba Fields from 70,000 barrels to 300,000 barrels per day. Initial production of 50,000 barrels per day from the Buzurgun and Abu Ghīrab Fields in southeastern Iraq, near the border of Iran, began late in the year. Further development to bring their output to 200,000 barrels per day included production from the new field at Fauqi in the same area. The fields were connected to Iraq's Persian Gulf export terminals by a 170-kilometer, 68-centimeter pipeline that was completed during 1976.

Petrobrás Internacional S/A (BRASPETRO), the foreign exploration arm of Brazil's Petróleo Brasileiro S/A (PETROBRAS), had an oil find at the 1 Manjoon wildcat well in its 3,050-square-mile service contract area in southern Iraq between Basrah and Buzurgun. The discovery flowed at 4,000 barrels per day, and the oil pool was estimated to contain 1 billion to 2 billion barrels of oil. Several other new oilfield discoveries had been indicated but detailed information was not available by yearend.

The 545-kilometer, 20-centimeter Baghdad-to-Basrah petroleum product pipeline was nearly completed during 1976 and was to be in full operation in early 1977.

Refinery production could be transferred in either direction depending on demand. Capacity of the line is to be 1.5 million tons per year. The 1,005-kilometer, 102-centimeter Kirkuk-to-Dörtyol (Turkey) crude oil pipeline was nearing completion during the year. The line is to be in service in 1977, with an initial throughput of 500,000 barrels per day, rising in intervals to 700,000 barrels per day by 1984. Turkey is to offtake 200,000 barrels per day from the line, and the remainder is to be shipped by tanker to European markets. Construction of a 122-centimeter crude oil pipeline from northern Rumaila to the Persian Gulf export terminals continued in 1976. Construction of a 35-kilometer, 122-centimeter natural gas pipeline from the southern Rumaila Field to Khor al Zubair commenced during the year. Nippon Kokan K.K. of Japan was the contractor for the natural gasline, and the $90 million contract included construction of dehydration and liquid separation facilities. The natural gasline is to transport about 2.4 million cubic meters of gas per day when completed in 1977.

The 655-kilometer north-south strategic oil pipeline from Al Ḥadīthah to Rumaila was used to export Kirkuk crude oil in January 1976. The reversible flow capability of the pipeline allowed Iraq the flexibility of delivering crude oil from the major producing centers, Kirkuk in the north and Rumaila in the south, to either Mediterranean or Persian Gulf export terminals.

Early in 1976, Iraq shut down the 1.4-million-barrel-per-day oil pipeline from Al Ḥadīthah to Syria and shifted Kirkuk exports to the deepwater port of Khor al-Maya in the Persian Gulf. Iraq and Syria failed to agree on transit fees to be paid by Iraq to Syria and on the cost of Iraqi crude oil that was blended with Syrian oil for use at Syrian refineries. After the shift, the cost of Kirkuk oil at Persian Gulf terminals was reported to be 5% lower than it had been at the Mediterranean ports of Banias, Syria, and Tripoli, Lebanon.

Iraq's oil-refining capacity was rated at 183,500 barrels per day, with the 71,000-barrel-per-day plant at Basrah and the 70,000-barrel-per-day plant at Daura near Baghdad making up most of the total. In February, Technoexport of Czechoslovakia received a contract to double the size of the Basrah refinery, but the terms of the contract and the expected completion date were not announced. A consortium of Thyssen Rheinstahl Technic of Düsseldorf, West Germany, and Lummus Company, a subsidiary of Combustion Engineering, Inc., of New York, received a $1.1 billion contract in February to construct a petrochemical complex near Basrah. The turnkey project, to be onstream in 1982, was to produce 60,000 tons per year of polyvinyl chloride, 45,000 tons per year of caustic soda, 60,000 tons per year of low-density polyethylene, 30,000 tons per year of high-density polyethylene, and 130,000 tons per year of ethylene.

The Mineral Industry of Ireland

By William F. Keyes [1]

In 1976, the Irish economy recovered from the recession experienced in 1975; by yearend, industrial output was slightly above that of the prerecession peak of March 1974. The index of industrial production increased from 280 in 1975 to 308 in 1976, but increases were unevenly distributed among the various sectors of the economy. In the mineral production sector, mine output of lead, zinc, copper, and peat, and refinery throughput of petroleum all declined, but there was a promise of significant growth in the mineral industry in the future.

During the year, exploration activity was intense, especially in the Navan, County Meath area, where two zinc mines were scheduled to start production, and in the Robertstown, County Kildare area. A decision was made by the Government to construct a zinc smelter, a manganese dioxide plant and a barite mine were started up, and a major offshore natural gasfield was being readied for production.

On March 1, 1976, stricter terms for prospecting licenses were introduced by the Ministry for Industry and Commerce. Fees, work commitments, and limitations on permissible expenditures and license renewals were instituted to prevent holding of claims for an excessive length of time. Other new legislation concerning ownership and exploitation of mineral deposits was under study by the Ministry, which resulted in a record-high level of exploration activity. Companies involved in exploration included Amax Explorations, Inc., Dresser Minerals International Inc., Preussag AG, New Jersey Zinc Company, Société Nationale des Pétrole d'Aquitaine, Canadian Superior Explorations Ltd., Péchiney Ugine Kuhlmann, Noranda Mines Ltd., Athlone Prospecting and Development Corp. Ltd. (United States Steel), Northgate, and Messina (Transvaal) Development Company Limited. Eleven new licenses for petroleum exploration offshore were awarded to 36 companies.

PRODUCTION

Ireland produced about 1% each of the world's lead and zinc in 1976. Copper production declined owing to the closing of one mine. Cement was domestically important, and barite production was modest, but expected to increase. For electricity generation, Ireland depended heavily on peat, which supplied over 25% of the country's energy.

The principal producers of minerals and metals in Ireland in 1976 are listed in the following tabulation:

[1] Supervisory physical scientist, International Data and Analysis.

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Barite	Magcobar Ltd., mine at Silvermines, Magnet Cove Barium Corp., United States	100
Cement	Cement Ltd., plants in Counties Heath and Limerick	100
Copper	Avoca Mine Ltd., mine at Arklow, Avoca Mine, Canada	90
Lead-zinc	Tara Mines Ltd., mine at Navan, Tara Exploration and Development Co., Ltd., Canada	(start 1977)
Do	Mogul of Ireland Ltd., mine at Silvermines, Kerr-Addison, Canada	60
Do	Irish Base Metals, mine at Tynagh, Northgate, Canada	40
Natural gas	Marathon Petroleum Ireland Ltd., offshore County Cork, Marathon Oil Company, United States	(start 1978)
Peat	Bord na Mona, various sites, Irish Government Peat Board	75
Petroleum products	Irish Refining Co. Ltd., refinery at Whitegate, near Cork, Irish Government	100

Table 1.—Ireland: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Copper, mine output, metal content	12,701	9,856	4,064
Lead, mine output, metal content	37,695	36,273	34,042
Iron and steel, crude steel—thousand tons	110	82	[e] 80
Mercury—76-pound flasks	775	423	NA
Silver, mine output, metal content—thousand troy ounces	1,980	1,384	925
Zinc, mine output, metal content	66,348	66,653	62,792
NONMETALS			
Barite	344,600	295,000	323,000
Cement, hydraulic—thousand tons	1,669	1,561	1,569
Gypsum—do	384	331	355
Lime—do	[e] 79	78	69
Pyrite—do	57	70	65
Sand and gravel [2]—do	6,182	5,036	5,770
Stone, limestone [2]—do	8,108	6,920	7,292
Other [3]—do	3,092	3,288	2,829
MINERAL FUELS AND RELATED MATERIALS			
Coal, anthracite and bituminous—do	68	48	49
Coke, gashouse (including breeze)—do	36	35	[e] 35
Peat:			
Agricultural use—do	[e] 74	67	71
Fuel use:			
Briquets—do	312	359	308
Sod peat [4]—do	1,935	2,099	3,813
Milled peat [5]—do	2,324	4,776	1,834
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	[r] 4,647	4,277	3,528
Jet fuel—do	[r] 763	823	160
Distillate fuel oil—do	[r] 3,228	4,476	3,812
Residual fuel oil—do	[r] 11,501	7,678	5,714
Other:			
Liquefied petroleum gas—do	[r] 456	470	278
Naphtha—do	[r] 366	312	162
Refinery fuel and losses—do	801	836	616
Total—do	[r] 21,762	18,872	14,270

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, substantial quantities of stone, sand, and gravel are produced by local authorities for such purposes as road maintenance, but statistics on output are not reported and available general information is inadequate to make reliable estimates of output levels.

[2] Excludes output by local authorities.

[3] Figures given as reported in source; includes granite, marble, silica rock, sand, calcspar, fire clay, and shale and clays for cement production, but excludes output of these materials by local authorities.

[4] Includes production by farmers and by Bord Na Mona.

[5] Includes milled peat used in the production of peat briquets, listed previously in this table.

TRADE

Because Ireland's small mineral industry is not diversified, most of the country's mineral products are imported. Petroleum products and iron and steel come from the United Kingdom, the nearest source, whereas crude petroleum has in the past come from the Middle East; this picture may change, however, when North Sea oil reaches export markets. Irish lead, zinc, and copper concentrates are presently smelted on the continent; this will change when the first Irish zinc smelter is to be built in the next few years.

Table 2.—Ireland: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys:			
Scrap	459	637	United Kingdom 341.
Unwrought and semimanufactures	4,326	3,970	United Kingdom 2,708; Jordan 446; West Germany 419.
Copper:			
Ore and concentrate	32,222	41,268	Spain 18,350; Sweden 13,726.
Metal including alloys:			
Scrap	4,643	4,480	West Germany 1,474; United Kingdom 1,272; Belgium-Luxembourg 827; Netherlands 548.
Unwrought	14,144	423	United Kingdom 317.
Semimanufactures	1,472	1,076	United Kingdom 849; United States 219.
Iron and steel:			
Roasted iron pyrite	29,019	27,645	NA.
Metal:			
Scrap	11,196	7,522	Italy 2,218; United Kingdom 1,546; Spain 1,489; Norway 1,050.
Semimanufactures	43,020	27,182	United Kingdom 22,028.
Lead:			
Ore and concentrate	74,195	58,641	France 21,673; Netherlands 13,419; West Germany 12,813; Belgium-Luxembourg 8,696.
Metal including alloys, unwrought and semimanufactures	4,683	2,868	All to United Kingdom.
Nickel metal unwrought and semimanufactures	178	128	West Germany 39; Switzerland 38; United Kingdom 14.
Platinum-group metals and silver:			
Ore and concentrate	11	7	NA.
Metals including alloys, all forms:			
Platinum ----------value, thousands--	$1,531	$597	All to United Kingdom.
Silver ----------do----	$494	$124	NA.
Zinc:			
Ore and concentrate	133,916	146,535	NA.
Metal including alloys:			
Scrap	588	NA	
Unwrought and semimanufactures	463	546	United Kingdom 542.
Other:			
Ore and concentrate	173	NA	
Ash and residue containing nonferrous metals	584	601	United Kingdom 262.
Metals including alloys, all forms, n.e.s	238	325	NA.
NONMETALS			
Abrasives, natural, n.e.s	52	6	NA.
Asbestos	217	255	NA.
Cement	156,956	117,187	United Kingdom 86,166; Nigeria 31,021.
Clay and clay products:			
Crude clays, n.e.s	34,555	43,246	United States 42,996.
Products:			
Refractory (including nonclay bricks)	63,801	59,656	United Kingdom 13,798; West Germany 10,442; Belgium-Luxembourg 7,944.
Nonrefractory	4,907	6,584	All to United Kingdom.
Fertilizer materials:			
Crude:			
Phosphatic	947	1,300	NA.
Other	2,694	950	NA.

See footnotes at end of table.

Table 2.—Ireland: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Fertilizer materials—Continued			
Manufactured:			
Nitrogenous	9,447	14,959	United Kingdom 14,909.
Phosphatic	96,665	30,514	Yugoslavia 11,000; Indonesia 8,500; Netherlands 8,468.
Potassic	1,007	1,287	All to United Kingdom.
Other	100,695	50,507	United Kingdom 15,607; Iran 11,000; Cuba 10,000; Guatemala 8,400; Venezuela 5,500.
Gypsum and plasters	85,296	67,594	NA.
Lime	13	NA	
Mica, all forms	6	5	NA.
Salt	221	194	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	292	348	NA.
Worked	150	239	United Kingdom 153.
Gravel and crushed stone	295,708	368,280	NA.
Limestone	(1)	67,594	NA.
Sand, excluding metal bearing	223	3,192	NA.
Sulfur, elemental, other than colloidal	27,593	NA	
Other nonmetals, n.e.s.:			
Crude	333,950	279,132	NA.
Slag, dross and similar waste, not metal bearing	38	116	NA.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	13,133	11,138	United Kingdom 7,647; Hong Kong 2,722.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	51	254	NA.
Coal and briquets:			
Anthracite and bituminous coal	32,189	56,229	United Kingdom 44,953; Netherlands 6,214.
Briquets of anthracite and bituminous coal	6,705	NA	
Coke and semicoke	40,839	37,900	Sweden 25,170; Netherlands 12,730.
Peat, including briquets and litter	127,634	115,395	United Kingdom 114,463.
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	46	88	United Kingdom 51; Nigeria 34.
Kerosine ---do	2	1	NA.
Distillate fuel oil ---do	168	298	United Kingdom 224; Netherlands 74.
Residual fuel oil ---do	2,628	2,557	All to United Kingdom.
Lubricants ---do	8	14	Do.
Other:			
Liquefied petroleum gas ---do	33	7	NA.
Unspecified ---do	--	343	All to United Kingdom.
Total ---do	2,885	3,308	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	4,012	8,503	Do.

NA Not available.

[1] Included with gypsum and plasters.

Table 3.—Ireland: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	10	NA	
Oxide and hydroxide	3,249	2,764	NA.
Metal including alloys:			
Scrap	770	323	NA.
Unwrought	6,326	5,336	United Kingdom 3,314; Canada 975; Norway 541.
Semimanufactures	10,487	6,223	United Kingdom 5,004.
Arsenic trioxide, pentoxide, acids	74	NA	
Chromium:			
Chromite	13,051	9,240	All from Turkey.
Oxide and hydroxide	53	40	NA.
Cobalt oxide and hydroxide	31	NA	
Copper metal including alloys:			
Scrap	127	30	NA.
Unwrought	274	190	United Kingdom 182.
Semimanufactures	11,403	11,464	United Kingdom 10,443.
Iron and steel metal:			
Ore and concentrate	NA	101	NA.
Scrap	25,266	3,825	All from United Kingdom.
Pig iron, including cast iron	5,904	1,164	United Kingdom 626.
Sponge iron, powder, shot	736	1,044	United Kingdom 803.
Ferromanganese	840	1,035	Belgium-Luxembourg 560.
Steel, primary forms	13,111	6,514	NA.
Semimanufactures:			
Bars, rods, angles, shapes, sections	284,434	81,677	United Kingdom 47,114; West Germany 14,813.
Universals, plates, sheets	252,870	86,189	United Kingdom 31,039; West Germany 16,941; France 9,419; Japan 9,305.
Hoop and strip	9,954	7,184	United Kingdom 6,079.
Rails and accessories	12,172	8,282	United Kingdom 7,799.
Wire	15,563	11,109	United Kingdom 6,085; Netherlands 3,158.
Tubes, pipes, fittings	139,494	40,019	United Kingdom 25,877; West Germany 4,354.
Castings and forgings, rough	5,328	1,413	United Kingdom 995; Italy 387.
Total	719,815	235,873	
Lead:			
Oxides	3,752	3,208	NA.
Metal including alloys, all forms	2,192	1,930	United Kingdom 1,906.
Magnesium metal including alloys, all forms	7	16	NA.
Manganese:			
Ore and concentrate	35	27,116	Japan 21,494; Ghana 5,588.
Oxides	795	744	NA.
Mercury ---76-pound flasks	58	87	NA.
Molybdenum metal including alloys, all forms	2	1	NA.
Nickel:			
Ore and concentrate	9	NA	
Matte, speiss, and similar materials	9	NA	
Metal including alloys:			
Scrap	--	6	NA.
Unwrought and semimanufactures	372	860	United Kingdom 525; United States 199.
Platinum-group metals and silver including alloys:			
Platinum group ---value, thousands	$456	$840	United Kingdom $810.
Silver ---do	$775	$696	United Kingdom $581.
Rare-earth metals including alloys	16	37	NA.
Tin:			
Ore and concentrate	2	NA	
Oxides	334	215	NA.
Metal:			
Scrap	4	NA	
Unwrought and semimanufactures	74	56	United Kingdom 52.
Titanium oxides	3,671	2,675	NA.
Tungsten metal including alloys, all forms	3	(1)	NA.
Zinc:			
Oxides	1,085	527	NA.
Metal including alloys:			
Scrap	372	228	All from United Kingdom.
Unwrought	2,325	2,418	United Kingdom 1,750; Canada 324.
Semimanufactures	1,656	929	United Kingdom 754.
Other:			
Ore and concentrate	1,261	154	NA.
Ash and residue, containing nonferrous metals	429	298	NA.
Oxides, hydroxides and pentoxides of metals, n.e.s	181	183	NA.
Base metals including alloys, all forms	145	135	NA.

See footnotes at end of table.

Table 3.—Ireland: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS			
Abrasives, natural:			
Crude, n.e.s ——value, thousands	$357	$236	United Kingdom $114.
Grinding and polishing wheels and stones	656	444	United Kingdom 299; West Germany 83.
Asbestos	7,610	6,847	Cyprus 2,729; Mozambique 1,683; Republic of South Africa 1,462.
Barite and witherite	199	122	NA.
Boron materials:			
Crude natural borates	1,849	1,048	NA.
Oxide and acid	165	146	NA.
Cement	19,202	47,492	United Kingdom 46,593.
Chalk	6,192	6,711	NA.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s	29,212	21,176	NA.
Products:			
Refractory (including nonclay bricks)	49,499	20,700	United Kingdom 17,539.
Nonrefractory	7,507	7,469	United Kingdom 6,116.
Diamond, all grades ——value, thousands	$42	NA	
Feldspar and fluorspar	7,393	5,560	NA.
Fertilizer materials:			
Crude:			
Nitrogenous	24	NA	
Phosphatic	449,270	146,253	Morocco 143,454.
Potassic	2,775	3,892	France 2,273; Belgium-Luxembourg 1,600.
Other	578	162	NA.
Manufactured:			
Nitrogenous	158,839	151,298	United Kingdom 65,995; Netherlands 47,599; Belgium-Luxembourg 18,026.
Phosphatic	271,417	116,394	Belgium-Luxembourg 84,786; United Kingdom 23,579.
Potassic	268,727	166,047	West Germany 42,912; France 40,521; West Germany 36,635.
Other	151,897	114,199	United Kingdom 77,566; Belgium-Luxembourg 23,563.
Ammonia	85,024	92,215	NA.
Graphite, natural	134	81	NA.
Gypsum and plasters	2,752	3,236	NA.
Lime	5,114	6,189	All from United Kingdom.
Magnesite	26,904	33,490	NA.
Mica:			
Crude including splittings and waste	196	189	NA.
Worked	3	2	NA.
Pigments, mineral:			
Natural, crude	353	188	NA.
Iron oxides, processed	1,417	1,015	NA.
Precious and semiprecious stones, excluding diamond ——value, thousands	$496	$255	Italy $145.
Salt	63,950	65,249	United Kingdom 48,955; West Germany 14,859.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	11,815	13,877	NA.
Caustic potash, sodic and potassic peroxides	603	283	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	1,713	1,272	NA.
Slate	947	340	NA.
Other	1,302	2,462	NA.
Worked:			
Slate	89	73	NA.
Paving and flagstone	8	20	NA.
Other	243	368	NA.
Dolomite	1,548	2,164	NA.
Gravel and crushed stone	209,554	176,901	NA.
Limestone (except dimension)	3,019	2,016	NA.
Quartz and quarzite	1,473	645	NA.
Sand, excluding metal bearing	100,992	100,004	NA.
Sulfur:			
Elemental:			
Colloidal	95	17,979	NA.
Other than colloidal	99,575	27,889	Canada 18,565; France 9,049.
Sulfur dioxide	119	105	NA.
Sulfuric acid	57,092	40,931	NA.
Talc, steatite, soapstone, pyrophyllite	2,422	2,021	NA.

See footnotes at end of table.

Table 3.—Ireland: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Other:			
Crude nonmetals, n.e.s	6,131	6,931	NA.
Slag, dross, and similar waste, not metal bearing	709	115	NA.
Oxides and hydroxides of magnesium, strontium, and barium	653	91	NA.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals n.e.s	9,510	7,865	United Kingdom 7,204.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	3,239	1,849	United Kingdom 1,799.
Carbon black and gas carbon	7,821	6,540	NA.
Coal and briquets, anthracite and bituminous coal—thousand tons	894	670	Poland 483; United Kingdom 184.
Coke and semicoke—do	7	7	All from United Kingdom.
Hydrogen and rare gases	1,089	613	NA.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	19,163	16,842	Kuwait 5,957; Iran 5,026; Saudi Arabia 4,956.
Refinery products:			
Gasoline—do	4,647	4,794	United Kingdom 4,573.
Kerosine—do	1,847	1,798	Mainly from United Kingdom.
Distillate fuel oil—do	3,228	3,842	United Kingdom 3,081; U.S.S.R. 761.
Residual fuel oil—do	11,502	10,283	United Kingdom 7,373; U.S.S.R. 2,204.
Lubricants—do	316	273	United Kingdom 252.
Other:			
Liquefied petroleum gas—do	696	777	All from United Kingdom.
Mineral jelly and wax—do	29	(1)	NA.
Nonlubricating oils, n.e.s—do	87	14	NA.
Bitumen and other residues—do	709	679	NA.
Bituminous mixtures, n.e.s—do	43	36	NA.
Pitch and pitch coke—do	2	(1)	NA.
Total—do	23,106	22,496	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals—thousand tons	6	4	Mainly from United Kingdom.

NA Not available.
[1] Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—Construction of an 800,000-ton-per-year alumina plant was postponed by Alcan (Ireland) Ltd. The plant, which was to be located on Aughinish Island, County Limerick, in the Shannon estuary, had been under study for several years and was a joint venture of Alcan, Årdall og Sunndal Verk of Norway, and Gränges AB of Sweden. Postponement was attributed to the economic recession. Ireland has no indigenous bauxite production.

Copper.—In 1976, copper production continued to decline, totaling about 4,000 tons compared with 9,800 tons in 1975 and 13,000 tons in 1974. The decrease was caused largely by the closing of the Gortdrum mine in 1975. Most of the 1976 production came from the Avoca mine, south of Dublin, a marginal producer operated by Avoca Mines (Ireland) Ltd.; a small amount of copper was produced by the Tynagh lead-zinc mine of Irish Base Metals.

Lead-Zinc.—Three mining companies were active in the Navan area of County Meath, northwest of Dublin. At midyear, Sabina Industries of Canada reported that diamond drilling had indicated 1.3 million tons of ore grading 7.6% combined lead and zinc at its Rennicks and Bennett property. Later, a second ore body of somewhat lower grade was identified by Sabina and drilling continued. Exploration was being

conducted by Messina (Transvaal) Development Company Limited of the Republic of South Africa, which would take 47.5% of the property after an initial expenditure of about $500,000[2] on exploration and after making a feasibility study.

Bula Ltd., second of the mining companies in the Navan area, reported that exploration conducted on its behalf by Canadian Bechtel Corp. had resulted in the discovery of an estimated 13.5 million tons of ore averaging about 9.2% combined lead and zinc at Nevinstown, 1.5 miles northwest of Navan. Earlier reports estimated the deposit to be 22 million tons. A planning application was lodged with the Meath County Council to mine the deposit at a rate of 1.1 million tons of ore per year, producing 70,000 tons per year of combined metals. Approximately 40% of the ore body was to be extracted by open pit methods. Mining and milling were to be conventional, and capital cost was estimated at almost $50 million. Construction was to start in early 1977 and first production was expected in late 1978. Bula was controlled by Irish interests, with unspecified foreign backing. A 25% equity was granted to the Irish Government gratis, and an additional 24% was to be purchased by the Government for a sum to be arbitrated.

The largest mine in the Navan area, controlled by Tara Exploration and Development Co. Ltd., a Canadian firm, and operated by Tara Mines Ltd., continued to be developed on schedule; initial production was expected early in 1977. Final financial arrangements for the project were made as follows: About Can$100 million was to be provided by a consortium of Irish and Canadian banks; an additional Can$30 million was to come from the Export Development Corp. of Canada; and the remaining Can$150 million, plus a Can$15 million contingency fund, was to be equity capital. The four main groups participating in Tara Exploration reportedly were Cominco Ltd. (17.4%), Noranda (19.9%), and Northgate Exploration (10%), all of Canada, and Charter Consolidated Ltd. (10.8%) of the United Kingdom.

The Irish Industrial Development Authority (IDA) invited 40 firms to discuss proposals for a zinc smelter that would process concentrates from the Tara and Bula mines and produce 100,000 to 150,000 tons of zinc per year. In early 1977, the IDA selected the New Jersey Zinc Co. to make a 6-month feasibility study; the company was expected to be the operator and major shareholder. If construction begins in late 1978 as expected, the project could be completed by 1982.

During 1976, lead and zinc were produced in Ireland by the Tynagh mine of Irish Base Metals, County Galway, and by the Silvermines Ltd., mine in Tipperary, controlled by Mogul of Ireland Ltd.

Manganese.—A plant to produce electrolytic manganese dioxide was opened at midyear by Mitsui Denman (Ireland) Ltd. on a 28-acre site on Little Island, east of the city of Cork. The plant had a production capacity of 12,000 tons per year and represented an investment of about $25 million.

NONMETALS

Barite.—The Benbulbin mine in County Sligo was reopened by Sligo Bay Barites Co. Ltd., a subsidiary of Halliburton Company (Imco Inc.) of Dallas, Tex., with a planned production of 50,000 tons per year. In addition Milchem Minerals Ltd. increased production from tailings of the Tynagh mine. The bulk of production, however, continued to come from the Magcobar (Ireland) Ltd. mine at Silvermines, Tipperary.

Fertilizer Materials.—A $17 million loan was made by the European Investment Bank, an agency of the European Economic Commission, to Nitrigin Eireann Teoranta, owned by the Irish Government, for the construction of an ammonia-and-urea complex at Marino Point on Great Island in the harbor of Cork. Total fixed investment was estimated at about $110 million, and natural gas from the Kinsale Head Field will be used to fuel the complex.

MINERAL FUELS

Energy.—Production of indigenous energy was confined to peat, which decreased seasonally in 1976, plus a minor amount of semibituminous coal and hydroelectric power. Almost all remaining energy came from imported petroleum, processed in the one refinery, at Whitegate, Cork

[2] Where necessary, values have been converted from the Irish pound (£) to U.S. dollars at the rate of 1£=US$1.72.

Table 4.—Ireland: Supply and apparent consumption of fuels and power for 1974 and 1975

(Million tons of standard coal equivalent [1])

	Total energy	Coal, coke and peat	Petroleum and refinery products	Hydro-electric power
1974:				
Production	2.1	2.0	--	0.1
Imports	9.4	.9	8.5	XX
Exports	1.1	.1	1.0	XX
Apparent consumption	10.4	2.8	[2] 7.5	.1
1975:				
Production	3.5	3.4	--	.1
Imports	8.9	.7	8.2	XX
Exports	.8	.1	.7	XX
Apparent consumption	11.6	4.0	[2] 7.5	.1

XX Not applicable.
[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Includes refinery fuel and losses.

Source: 1974: United Nations. World Energy Supplies, 1950–74. Statistical Papers, Ser. J, No. 19, 1976. 1975: Organization for Economic Cooperation and Development. Energy Statistics, 1973–1975.

harbor, and from imported petroleum products. The Kinsale Head gasfield, offshore from the south coast, was expected to make a contribution starting in April 1979. A gross energy balance is given in table 4, based on consumption of all energy materials, whether used for that purpose or not.

Natural Gas.—Progress continued on bringing the Kinsale Head gasfield of Marathon Ireland into production, with a target date of April 1979 for first deliveries. Six offshore wells were drilled elsewhere in the Celtic Sea, south of Ireland, during 1976 but all were negative; dry wells drilled there totaled 29 by yearend. Some 11 concessions totaling 3,000 square miles were awarded to 36 companies in the Atlantic, west of Ireland, during the year; these brought the area under contract offshore to about 20,000 square miles, mostly in the Celtic Sea.

Petroleum.—Offshore petroleum licensing terms, revised in 1975, included the following provisions: The state may participate on an equity basis up to 50%; royalties range from 8% at a production rate of less than 40,000 barrels per day to 16% for 350,000 barrels per day; licenses are valid for 6 years (9 years for depths of more than 600 feet), renegotiable 5 years after initial production; the minimum exploration program requires drilling one well per block during the first 3 years; licenseholder may be required to train a reasonable number of people; rate of development must be approved by the Minister of Industry and Commerce; all production must be landed in Ireland; activities must be conducted from an Irish base; and exploration expenditures are chargeable against profits in the year they are incurred.

Uranium.—A subsidiary of Péchiney Ugine Kuhlmann commenced exploration in the granitic area of southwest Ireland. The European Economic Commission in 1976 established funds to finance exploration for uranium in the European Economic Community countries. About £314,000 ($540,000) was earmarked for exploration in Ireland.

The Mineral Industry of Israel

By David E. Morse [1]

Exploitation of Israel's modest natural resources in 1976 involved the processing of Dead Sea brine to produce potash, bromine, magnesium oxide, and industrial and table salts and the mining of phosphate rock, glass sand, clay minerals, copper ore, building stone, sand, and gravel. The output of the mineral industry furnished the base for Israel's ceramic and nonmetallic chemical industries. During 1976, mineral production declined because of the low world demand for fertilizer materials and the closing of the Timna copper mine on March 31. Geophysical exploration for oil increased significantly above the 1975 level and exploration drilling intensity was unchanged, but no important oil discoveries were reported in Israel during 1976.

Israel's economic growth continued to be sluggish in 1976. The real gross national product (GNP) increased 1.4% to $12 billion[2] after an increase of 0.4% in 1975. An encouraging aspect of the economy was the nearly $800 million drop in the balance of trade deficit. Government subsidy cuts and higher rates for Government services increased consumer costs during 1976. The unemployment rate rose from 3.1% in 1975 to 3.5% in 1976, although industrial employment increased by 6,000 to 298,000.

Starting in June 1975, the Government instituted a system of creeping devaluations of the Israeli pound (I£) with monthly devaluations of up to 2%. The pound was devaluated from I£7.10=US$1.00 to I£7.97=US$1.00 during the first half of 1976. The Government decided that, beginning July 19, 1976, the Israeli pound would be pegged to a basket of five currencies instead of to the U.S. dollar only. The five currencies and their initial basket rates were as follows: U.S. dollar 35%, pound sterling 23%, Deutsche mark 20%, French franc 14%, and Netherlands guilder 8%.

Israel had one of the most modern road systems in the Middle East, but had neglected its rail transport system. Expansion of the railroads was underway in 1976, with the line from Oron to the new phosphate mine at Hor Hahar nearly finished. Planned construction of a rail link from Oran to Eilat on the Gulf of Aqaba with a branch line to Sedom on the Dead Sea would require about $50 million for its expected 1983 completion.

Ninety-eight percent of Israel's known fresh water resources were being exploited in 1976, and desalinization of seawater was required to obtain fresh water for industrial and agricultural growth. Israel began intensive desalinization research in 1964 and had success with vapor-compression units, multiple-effect plants, and multiple-effect flash distilling plants. The 1-million-gallon-per-day plant that began operation at Eilat in 1974 was the largest built in Israel through 1976. Five similar multiple-effect flash distilling units were under construction in Israel in 1976. In 1975, an agreement was signed between Israel and the United States for the construction of a 10-million-gallon-per-day desalinization plant at Ashdod. Included in the project was a dual-purpose thermal powerplant to supply the electricity as well as the energy needed in the desalinization process. Israel would supply $35 million and the United States would assist with a $20 million loan for the project. A 100-million-gallon-per-day plant, to be powered by a dual-purpose nuclear reactor, was to be in operation by 1988.

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Israeli pounds (I£) to U.S. dollars at the rate of I£8.05=US$1.00.

PRODUCTION

Although Israel's 1976 industrial output increased 4%, the contribution from mining and quarrying decreased more than 25% to 1.7% of the total industrial output. The sales of potash fell 35% and crude phosphate rock output fell nearly 30%. Copper operations were terminated at the end of March. Cement, dimension and crushed stone, gypsum, iron and steel, sand, gravel, and petroleum refinery production levels were on a par with 1975 output. Bromine, flint clay, and magnesium oxide outputs increased in tonnage over those of 1975.

Table 1.—Israel: Production of mineral commodities
(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Copper cement (70%–80% Cu):			
Gross weight [e]	[r] 14,700	10,000	--
Metal content [e]	[r] 11,000	7,500	--
Iron and steel:			
Pig iron [e]	40,000	40,000	40,000
Crude steel [e]	[r] 75,000	[r] 60,000	70,000
NONMETALS			
Bromine:			
Elemental	18,000	18,000	20,900
Compounds	10,000	12,000	10,300
Cement, hydraulic ---thousand tons	[r] 1,800	2,184	2,004
Clays:			
Flint clay	44,000	66,000	70,000
Metabentonite	3,800	3,000	15,000
Kaolin	4,200	12,000	10,000
Other	1,200	2,000	4,000
Fertilizer materials:			
Crude:			
Phosphatic:			
Unprocessed ---thousand tons	2,442	2,326	1,630
Beneficiated ---do	1,026	882	639
Potassic:			
Gross weight (sales) ---do	921	1,159	754
K_2O equivalent ---do	562	707	460
Manufactured:			
Nitrogenous	122,022	176,557	182,288
Phosphatic (superphosphate)	220,100	246,100	288,900
Potassic	5,494	8,742	9,509
Gypsum	200,000	200,000	200,000
Lime	200,000	240,000	200,000
Salt, marketed (mainly marine)	112,756	114,947	86,561
Sand and gravel:			
Sand:			
Glass sand	83,500	74,000	84,000
Other (for building industry) --thousand cubic meters	3,500	5,000	4,500
Gravel ---do	500	14	13
Sodium and potassium compounds, caustic soda	20,458	24,156	24,009
Stone:			
Dimension, marble	16,000	16,000	16,000
Crushed ---thousand cubic meters	14,000	14,000	13,000
Sulfur:			
Byproduct from petroleum	[r] 8,500	10,200	10,000
Sulfuric acid ---thousand tons	187	194	208
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural, marketed ---million cubic feet	2,327	2,105	2,055
Peat [e] ---thousand tons	20	20	20
Petroleum:			
Crude:			
From Israel proper ---thousand 42-gallon barrels	281	250	262
From occupied Sinai [2] ---do	36,219	27,095	6
Refinery products:			
Gasoline ---do	8,644	7,768	7,999
Jet fuel ---do	4,536	4,334	4,521
Kerosine ---do	2,099	1,994	1,893
Distillate fuel oil ---do	10,111	12,130	13,136
Residual fuel oil ---do	21,998	19,456	20,014
Lubricants ---do	167	201	262
Other ---do	4,251	3,984	3,371
Refinery fuel and losses ---do	1,877	2,077	2,133
Total ---do	53,683	51,944	53,329

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the commodities listed, Israel reportedly has the capacity to produce 71 metric tons of U_3O_8 per year, but official data are not reported and available information is inadequate to make reliable estimates of output levels.

[2] Israeli control relinquished in November 1975.

TRADE

Polished diamond exports, the country's biggest single foreign exchange earner, were valued at $711.8 million. The 1976 sales were the diamond industry's largest to date and increased almost 30% over those of 1975. Total carat sales increased 22% from 2.7 million in 1975 to 3.3 million in 1976. The diamond industry employed 20,000 workers and planned to add 4,000 more because sales were expected to increase to $1 billion per year by 1980. Major importers of polished gem diamonds from Israel in 1976 were, in order of importance, the United States, Hong Kong, the Netherlands, Japan, Belgium, Switzerland, and the Federal Republic of Germany.

Mining and quarrying accounted for 3.0% of total industrial exports in 1976, a 40% decrease from the 5.2% in 1975. The decrease was attributed to declines in exports of phosphates and potash because of the decreased world demand for fertilizers and to the closing of the Timna copper complex. The import value of fuels increased 7.7% over the 1975 value because of greater dependence on foreign crude oil. About 50% of Israel's crude petroleum requirements had previously been supplied by the Abu Rodeis Field in the southwest Sinai. This Field was relinquished at the end of November 1975.

Table 2.—Israel: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974 [1]	1975 [1]	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms [2]	r 1,948	2,244	Iran 662; Belgium-Luxembourg 444; Netherlands 296.
Copper:			
Copper cement	12,512	9,595	United Kingdom 3,956; Spain 3,629; Hungary 2,004.
Matte [3]	1,981	173	Spain 72; Hong Kong 49; Switzerland 21.
Metal including alloys:			
Scrap [4]	194	208	Belgium-Luxembourg 100; West Germany 76; Italy 24.
Unwrought and semimanufactures [5]	1,054	853	Iran 607.
Iron and steel, metal including alloys, all forms [6]	16,227	5,651	Iran 2,275; United States 1,684.
Lead metal including alloys, all forms [7]	231	53	Belgium-Luxembourg 18; Italy 18; Malta 17.
Nickel metal including alloys, all forms	24	2	All to Belgium-Luxembourg.
Other:			
Ash and residue containing nonferrous metals	312	407	Netherlands 179; West Germany 140; United Kingdom 88.
Metals including alloys, all forms value, thousands	r $121	$740	West Germany $379; Belgium-Luxembourg $87.
NONMETALS			
Abrasives, natural, n.e.s., grinding and polishing wheels and stones value	$159,000	$198,000	Canada $92,000; United States $44,000; Turkey $29,000.
Barite and witherite	445	411	Mainly to Republic of South Africa.
Bromine [8]	r 1,790	1,367	Argentina 395; United Kingdom 214; Netherlands 173.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s. [9]	12,151	1,081	United Kingdom 632; Greece 347.
Products:			
Refractory (including nonclay bricks)	816	2,249	Mainly to Iran.
Nonrefractory value	$166,000	$321,000	Republic of South Africa $135,000; Canada $85,000; United States $55,000.
Diamond, gem, not set or strung [10] thousand carats	2,766	3,118	United States 1,005; Hong Kong 492; Netherlands 339.

See footnotes at end of table.

Table 2.—Israel: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974 [1]	1975 [1]	Principal destinations, 1975
NONMETALS—Continued			
Fertilizer materials:			
Crude phosphatic	421,650	259,127	Italy 62,616; Belgium-Luxembourg 54,934; Romania 52,323.
Manufactured:			
Nitrogenous	[11] 3,812	36	All to Brazil.
Phosphatic [12]	r 260,099	160,213	Austria 32,982; Norway 24,449; Yugoslavia 22,414.
Potassic ---value	$499,000	$673,000	Greece $517,000; Cyprus $121,000.
Other, including mixed	676,817	712,765	France 128,000; Japan 87,409; Italy 77,296.
Ammonia	4,684	4,645	Italy 3,126; Switzerland 1,515.
Lime	130	43	All to Ethiopia.
Magnesite	([13])	20,811	Austria 11,945; West Germany 7,330.
Precious and semiprecious stones, except diamond--value, thousands	$4,383	$4,860	Hong Kong $1,077; United States $966; Switzerland $833.
Salt	20	4	All to Netherlands.
Stone, dimension, all types	1,361	1,547	West Germany 552; Netherlands 527.
Sulfur:			
Elemental, all forms	41	41	All to Cyprus.
Sulfuric acid	196	329	Kenya 172; Ethiopia 157.
Other nonmetals, n.e.s.:			
Crude ---value, thousands	$200	$344	Nigeria $106; Ghana $100; Ivory Coast $70.
Slag and ash	76	103	Netherlands 70; West Germany 33.
Bromine, chlorine, fluorine, iodine	6,056	6,906	United Kingdom 1,967; Netherlands 1,232; Italy 873.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	5	--	
Carbon black	4,703	2,440	Thailand 981; Finland 501; Cyprus 420.
Hydrogen, helium, rare gases	4	53	Mainly to Greece.
Petroleum: [e 14]			
Crude and partly refined thousand 42-gallon barrels	35,611	26,065	NA.
Refinery products:			
Gasoline ---do	1,256	1,323	
Kerosine ---do	310	625	
Jet fuel ---do	445	977	
Distillate fuel oil ---do	1,750	2,127	
Residual fuel oil ---do	1,920	935	
Lubricants ---do	--	144	
Other ---do	1,477	1,046	
Total ---do	7,158	7,177	

[e] Estimate. [r] Revised. NA Not available.

[1] Data provided for 1974 and 1975 may be incomplete. The figures presented, unless otherwise specified, are the sum of listed detail for all countries for which a quantity figure is provided in official Israeli trade returns; additional quantities may have been exported to other countries for which only a value figure is provided. In some cases, where it is clear that a significant portion was exported for which no quantity figure was provided, the value figure has been provided in a footnote.

[2] Totals exclude quantities valued at $933,000 in 1974 and $1,452,000 in 1975.

[3] Totals exclude quantities valued at $231,000 in 1974 and $140,000 in 1975.

[4] Totals exclude quantities valued at $346,000 in 1974 and $461,000 in 1975.

[5] Totals exclude quantities valued at $16,000 in 1974 and $130,000 in 1975.

[6] Totals exclude quantities valued at $1,800,000 in 1974 and $13,639,000 in 1975.

[7] Totals exclude quantities valued at $949,000 in 1974 and $5,000 in 1975.

[8] Elemental bromine is included with chlorine, fluorine and iodine, and is reported in this grouping under "Other nonmetals" in this table.

[9] Totals exclude quantities valued at $1,000 in 1974 and $790,000 in 1975.

[10] Totals exclude quantities valued at $419,000 in 1974 and $322,000 in 1975.

[11] Total excludes quantity valued at $542,000.

[12] Totals exclude quantities valued at $28,000 in 1974 and $837,000 in 1975.

[13] Quantity not available but valued at $2,880,000 in 1974.

[14] U.S. Department of the Interior, Bureau of Mines. International Petroleum Annual, 1974 and 1975. March 1974 and March 1975.

Table 3.—Israel: Imports of mineral commodities

Commodity	Quantity (metric tons unless otherwise specified)		Value, thousands			
			Reported quantity		Additional unreported quantity	
	1974	1975	1974	1975	1974	1975
METALS						
Aluminum:						
Bauxite and concentrate	458	NA	$239	--	$1	$48
Oxide and hydroxide	536	307	516	$487	1	72
Metal including alloys, all forms	r 5,539	1,687	33,558	26,881	1,033	9,317
Chromium oxide, hydroxide, trioxide	33	NA	95	--	21	149
Copper:						
Matte	172	--	211	--	8	--
Metal including alloys, all forms	3,733	404	44,322	25,766	2,724	11,888
Gold metal, unworked or partly worked troy ounces	868	NA	198	--	19,040	29,541
Iron and steel metal:						
Scrap	18,260	2,637	3,975	2,256	17	--
Pig iron, ferroalloys, and similar materials	7,889	2,288	2,674	1,815	131	385
Steel, primary forms	r 73,062	17,125	26,852	10,777	576	3,877
Semimanufactures:						
Bars, rods, angles, shapes, sections	r 249,568	78,043	145,192	78,020	2,049	12,667
Universals, plates, sheets	r 274,362	25,732	151,721	41,581	3,795	60,496
Hoop and strip	r 4,440	684	5,531	2,865	560	2,524
Rails and accessories	1,134	35	2,308	64	25	1,344
Wire	r 11,035	110	14,817	230	686	12,049
Tubes, pipes, fittings	6,342	1,581	12,971	12,961	1,818	12,643
High carbon and alloy steel shapes, not further described	1,066	410	3,450	2,481	212	1,656
Lead:						
Oxides	117	230	734	885	61	60
Metal including alloys, all forms	1,504	122	2,391	281	378	1,811
Magnesium metal including alloys, all forms	33	NA	242	--	481	375
Manganese oxides	195	105	253	295	395	28
Mercury 76-pound flasks	29	29	21	14	198	107
Nickel metal including alloys, all forms	43	121	1,258	1,377	253	1,528
Platinum-group metals including alloys, all forms troy ounces	1,800	NA	956	--	322	475
Silver metal including alloys, all forms do	106,547	NA	1,314	--	2,501	6,023
Tin:						
Oxides	--	NA	--	--	--	31
Metal including alloys, all forms	r 2,552	7	878	518	552	395
Titanium oxides	655	83	3,361	759	258	1,412
Zinc:						
Oxides	182	28	998	275	15	479
Metal including alloys, all forms	2,027	941	5,460	2,872	700	2,061
Other:						
Ore and concentrate, n.e.s	191	230	71	97	7	116
Oxides, hydroxides, and peroxides of metals, n.e.s	37	3	655	108	81	692
NONMETALS						
Abrasives, natural, n.e.s.:						
Pumice, emery, natural corundum, etc	9,832	36	528	61	--	51
Corundum, artificial	89	3	613	98	36	--
Grinding and polishing wheels and stones	NA	NA	--	--	649	968
Asbestos	8,099	856	3,680	3,366	--	2,021
Barite and witherite	NA	NA	--	--	53	382
Boron materials: Oxide and acid	5	NA	--	--	16	141
Cement	459,576	35,878	40,712	3,683	383	27,798
Chalk	80	15	85	32	--	21
Clays and clay products (including all refractory brick):						
Crude clays, andalusite, kyanite, etc	7,006	NA	2,471	--	154	2,566
Products:						
Refractory (including nonclay bricks)	1,252	1,214	1,636	1,988	551	885
Nonrefractory	501	NA	152	--	5,561	2,823
Diamond:						
Gem, not set or strung thousand carats	6,120	6,894	442,961	469,266	--	--
Worked:						
Industrial do	1,486	1,742	4,279	7,211	--	--
Other do	53	63	15,888	11,910	616	2,181
Diatomite and other infusorial earth	388	NA	198	--	4	230
Feldspar and fluorspar	2,867	9,095	408	98	30	237

See footnotes at end of table.

Table 3.—Israel: Imports of mineral commodities—Continued

Commodity	Quantity (metric tons unless otherwise specified)		Value, thousands			
			Reported quantity		Additional unreported quantity	
	1974	1975	1974	1975	1974	1975
NONMETALS—Continued						
Fertilizer materials:						
Crude phosphatic	30	--	63	--	--	--
Manufactured:						
Nitrogenous	6,548	252	1,554	655	490	3,342
Other, including mixed	100	NA	154	--	24	23
Graphite, natural	38	4	61	14	--	34
Gypsum and plasters	146	29	57	25	--	52
Magnesite	556	475	119	126	200	40
Mica, crude, including splittings and waste	29	8	29	21	36	46
Pigments, mineral: Iron oxides, processed	128	NA	322	--	--	365
Precious and semiprecious stones except diamond:						
Natural	NA	NA	--	--	5,105	6,749
Manufactured, including synthetic	NA	NA	--	--	277	267
Salt	--	29	--	20	--	178
Sodium and potassium compounds, n.e.s	385	344	677	496	13	472
Stone, sand and gravel:						
Dimension stone:						
Crude and partly worked	292	19	371	18	157	643
Worked	NA	NA	--	--	350	473
Gravel and crushed rock	7,984	1,128	649	734	16	62
Quartz and quartzite	388	101	104	64	28	40
Sand, excluding metal bearing	--	NA	--	--	--	43
Sulfur:						
Elemental, all forms	41,544	73	4,249	294	70	6,004
Sulfuric acid	NA	NA	--	--	1,949	2,963
Talc, steatite, soapstone, pyrophyllite	1,262	42	303	202	--	30
Other nonmetals:						
Crude mineral substances, n.e.s	526	3	250	86	--	201
Oxides and hydroxides of magnesium, strontium, barium	28	NA	95	--	12	77
Bromine, iodine, fluorine	--	2	--	16	--	28
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	20	NA	79	--	17	228
Unspecified	35	23	189	37	74	109
MINERAL FUELS AND RELATED MATERIALS						
Carbon black	165	168	768	889	37	19
Coal, all grades	340	222	716	177	--	66
Coke and semicoke	1,010	NA	277	--	--	684
Peat, including peat briquets and litter	6	NA	32	--	50	85
Rare gases (argon)	33	14	36	46	12	43
Petroleum: [e]						
Crude and partly refined thousand 42-gallon barrels	55,820	53,555	NA	NA	NA	NA
Refinery products:						
Gasoline (including natural):						
Aviation ---do---	130	125				
Motor ---do---	565	368				
Kerosine ---do---	520	330				
Jet fuel ---do---	1,220	425	NA	NA	NA	NA
Distillate fuel oil ---do---	335	1,265				
Residual fuel oil ---do---	--	2,550				
Lubricants ---do---	775	634				
Other ---do---	844	345				
Total ---do---	4,389	6,042	NA	NA	NA	NA
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	569	475	227	--	13	69

[e] Estimate. [r] Revised. NA Not available.

COMMODITY REVIEW

METALS

Copper.—The Timna mining complex, located about 20 kilometers north of Eilat in southern Israel, was closed at the end of March 1976 because the operation was not economically viable at the then-current price of copper. Since Timna opened in 1959, about 150,000 tons of copper cement (80% copper content) was exported for a return of $140 million. About 14 million tons of copper ore had been extracted, and remaining reserves are estimated at 14 million tons containing 1.1% to 1.3% copper. A staff of 50 was retained for maintenance of the mine and equipment. The Government planned to reopen the mine when the price of copper makes the operation economically favorable.

Magnesium.—Dead Sea Periclase Ltd. manufactured periclase (high-purity magnesium oxide (MgO)) from Dead Sea Works Ltd.'s (DSW) residual brines. The brines, after potash and bromine extraction, were pumped by pipeline to the MgO plant on the Rotem Plain above the Dead Sea. Improvements to the kilns during 1976 increased the MgO output 25% to about 25,000 tons. Magnesium oxide is primarily used in the manufacture of high-temperature refractory bricks. Nearly 54,000 tons of hydrochloric acid was produced as a byproduct and shipped to the adjacent phosphoric acid plant operated by Arad Chemical Industries Ltd.

NONMETALS

Bromine.—Dead Sea Bromine Ltd., a subsidiary of DSW, used the residual brines from potash extraction at the adjacent DSW plant to produce liquid bromine. The brines contained 10 to 12 grams of bromine per liter compared with the natural concentration of 4.6 grams per liter in the Dead Sea. Bromine gas was liberated by heating the brines in a chlorine atmosphere. The bromine gas was condensed, collected, and shipped by truck in lead-lined 14-ton tanks. Dead Sea Bromine's 1976 output was about 21,000 tons of bromine and 4,700 tons of ethylene dibromide. Expansion at the facility was underway in 1976 to raise the capacity from 22,000 to 55,000 tons per year by yearend 1978 and included the construction of a 33,000-ton-per-year electrolysis plant for chlorine production. A portion of the 1976 bromine production was shipped to a sister company, Bromine Compounds Ltd. at Be'er Sheva, for the manufacture of ethylbromide, sodium bromide, potassium bromide, and ammonium bromide for industrial uses. Bromine Compounds planned to begin production in a new plant south of Be'er Sheva by 1978. The new plant was designed to process 20,000 tons of raw bromine per year.

Cement.—Most of Israel's demand for cement in 1976 was met by Nesher Cement Ltd., the country's only producer. Output from Nesher's plants at Haifa, Ramale, and Bet Shemesh was over 2 million tons, an 8% decrease from that of 1975.

Clays and Sand.—Israel's requirements for industrial sand and clays were supplied by Negev Ceramics Ltd. Nearly-pure quartz sand and various clays for the glass and ceramic industries were mined from the Great Crater near Yeruham. Flint clays for refractories were mined and processed in the Ramon Crater. Both mining areas are located in the northern Negev Desert.

Fertilizer Materials.—*Phosphorus.*—Israel's phosphate reserves in the Negev were estimated to exceed 300 million tons in over 20 deposits. Negev Phosphates Ltd. (NPL) operated the Oran and Little Crater mines at reduced output during the year. NPL began development work at the new phosphate mine, Hor Hahar, in the Zin Valley and started construction on the beneficiation plant. Mining operations were to begin in 1978 and reach full production of 1 million tons per year by 1980. When the Hor Hahar mine reaches full output, Israel's crude phosphate capacity will be about 3 million tons per year.

Arad Chemical Industries Ltd., a subsidiary of Negev Phosphate, operated a phosphoric acid plant on the Rotem Plain and a phosphate mine nearby at Mishor Rotem in 1976. Arad processed phosphate rock with hydrochloric acid to produce phosphoric acid. Hydrochloric acid was manufactured at the plant by processing residual brines pumped from the DSW plant at Sedom in fluidized-bed reactors. Technical difficulties in the reactors had not been overcome and they were secured late in the year. The company continued to produce phosphoric acid by using the

hydrochloric acid output of the adjacent MgO plant.

Potassium.—Israel's source of potassium is the natural 1% concentration of potassium chloride (KCl) in the water of the Dead Sea. DSW concentrated the KCl by solar evaporation of the water in an extensive system of diked ponds. The hydrated double salt carnalite ($KCl \cdot MgCl_2 \cdot 6H_2O$) formed on the bottom of the ponds, and a slurry of brine and carnalite was harvested by dredgers and pumped to the extraction plant. The KCl concentration of the slurry was about 22%. KCl was recovered using a reverse brine flow process to remove magnesium chloride ($MgCl_2$) and a hot-leach process to separate KCl from sodium chloride. In 1976, DSW also produced potassium sulfate, potassium nitrate, table salt, magnesium chloride, and various brines. DSW's sales during 1976 fell about 35% because of low world fertilizer demand. Extension of the pond system was underway in 1976 to increase the annual production capacity to 1.5 million tons of KCl. DSW also planned to increase output of table salt from 20,000 to 50,000 tons per year.

In 1976, Haifa Chemicals Ltd. produced fertilizer-grade and technical-grade potassium nitrate at its plants in Haifa. Fertilizer grade (NPK–13–0–46) was used for applying chlorine-free potash, and technical grade (99.9% pure) was used by the ceramic, explosives, and printing industries. Haifa Chemicals commissioned its second 110,000-ton-per-year plant late in the year. The original 110,000-ton-per-year plant had been extensively damaged by fire in June; repairs were expected to be completed by mid-1977. Over 90% of Haifa's 1976 potassium nitrate output, manufactured from domestic raw materials, was exported.

MINERAL FUELS

Energy.—In 1976, Israel's 12 thermal powerplants had a generating capacity of nearly 1,800 megawatts and were located along the Mediterranean coastal plain. During the year, Israel invested over $5 million in research and development of domestic nonpetroleum energy sources. Areas under investigation included exploitation of Israel's oil shale and peat resources, increased use of solar energy, and exploitation of the hydroelectric potential from the Mediterranean Sea to the Dead Sea. Nearly $500,000 was to be spent to determine if there was economic justification for constructing a tunnel to carry water from the Mediterranean Sea to ponding areas near the Dead Sea for the production of electricity. Probable incorporation in this project would be the use of the water to cool a dual-purpose nuclear powerplant and desalinization plant.

Coal.—The Government authorized the construction of a coal-fired powerplant at Hadera near the central Mediterranean coast. The powerplant would have four 300-megawatt units and would require over 3 million tons of imported coal per year for operation. To reduce coal importation, surveys were initiated on domestic coal deposits and on the abandoned coal mine at Jebel Mghara in northwest Sinai. It was estimated that reserves at the mine were over 35 million tons of coal. The Government had not made a decision concerning mining operations at Jebel Mghara in 1976.

Petroleum.—After relinquishing control of the Sinai oilfield in November 1975, Israel became highly dependent on outside sources for crude oil. Oil production from Israel's only oilfield, the 20-year-old Helez Field, was under 700 barrels per day and supplied less than 1% of the total crude oil demand. An intensive exploration effort was planned to determine the extent of Israel's oil resources and to reduce dependence on imports. Extensive geophysical exploration was planned for areas along the Mediterranean coastal plain and shelf, the southern end of the Dead Sea, and the northern Negev. Exploratory drilling was to include 10 to 15 wells per year onshore and 4 or more per year offshore.

At the beginning of 1976, the Paz Oil Co. Ltd. held permits for 375 square miles along Israel's west coast and 50 square miles southwest of the Dead Sea. Oil Exploration Ltd. held permits for a 135-square-mile area near the west Negev and a 95-square-mile area in the Dead Sea. By mid-1976, approximately 25 leases had been awarded to local and foreign companies in areas that included most of Israel's Mediterranean continental shelf.

The general level of geophysical exploration increased during the year, although the number of exploratory wells drilled was comparable with that of 1975. No important oil discoveries were made during

the year; however, the Ashdod–2 well, drilled near the Mediterraean coast, had a show of oil. Ashdod–3 was drilled nearby in an eflort to find an oil reservoir, but without positive results. A fourth well was planned for the same general area. Exploratory wells were also drilled in the Dead Sea, at Caesarea, and near Aṭ Ṭūr in the southwest Sinai. The Government leased a drill ship for offshore exploration drilling near yearend. Drilling operations were to be conducted on the Mediterranean shelf by the United Kingdom contractor under the direction of the Israeli National Oil Co.

Israel's petroleum refining capacity in 1976 was 10 million tons per year (6.5 million at Haifa and 3.5 million at Ashdod). An additional 3.5-million-ton-per-year unit under construction at Haifa was scheduled to be completed in early 1978. The 1976 refinery input was about 7.3 million tons, which was approximately the same as the 1975 input.

The Mineral Industry of Italy

By Roman V. Sondermayer [1]

Despite lingering economic problems, 1976 was a year of recovery for the Italian mineral industry. According to published indicators, the index of mining activity showed an increase of about 4% when compared with 1975. However, this increase in mining output was not followed by a corresponding increase in industrial activity, and a substantial increase in stocks was registered in the second half of the year.

Italy remained an important processor of mostly imported raw minerals and crude oil and a producer of metals, petroleum products, and nonmetals. Pumice, feldspar, cement, gypsum, pyrite, fluorspar, barite, asbestos, and zinc were among the major minerals mined in the country. Steel, lead, zinc, and aluminum metals were produced, but primary copper was not mined or refined, and all copper requirements were met through imports.

The mineral industry generated about 1.1% of the gross national product (GNP) and employed 220,000 persons.

Marginal mining operations, mostly Government owned, continued operations during 1976, since closure of such mines, often the only source of employment in the area, would create social problems. The Government-owned concern, Ente Autonomo di Gestione per le Aziende Minerarie Metallurgiche (EGAM), operator of those mines, was in serious financial difficulties during the year. A new law imposing strict control of liquid waste disposal was passed during 1976. This law and other environmental requirements, together with higher labor costs, have affected the profitability of mining operations.

In 1976, major events in the mineral industry were as follows: Small lead and zinc deposits were discovered in Sardinia and northeast Italy, production of mercury stopped in July, development of the Campiano pyrite mine continued, a new company for salt production was organized in Sicily, and several modest gasfields and oilfields were discovered offshore and onshore.

PRODUCTION

During 1976, output of mineral and related commodities showed mixed results, as shown in table 1. The mineral industry was owned by both Government and private concerns; the structure of the industry, with approximate share of the country's totals, is shown in the following tabulation:

[1] Physical scientist, International Data and Analysis.

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	Aluminio Sarda S.p.A., smelter at Porto Vesme, Government 94%	40
Do	Alummetal S.p.A., smelters at Bolzano, Fusina, and Mori, Government 90%	38
Asbestos	Amantifera di Balangero S.p.A., mine at San Vittore	90
Barite	Societá Bariesarda S.p.A., mines at Barega, M. Mesu, and Montega	50
Cement	Italcementi S.p.A., 20 plants (largest at Colleferro, Bergamo, and Brescia)	37
Do	Unicem S.p.A., 7 plants (largest at Guidonia-Roma)	9
Do	Cementi-Cementerie del Tirreno, 6 plants (largest at Naples)	11
Ferroalloys	Montedison S.p.A., plants at Apuiana, Domodossola, and St. Marcel/Aosta, Ente Nazionale Indrocarburi (ENI)	60
Do	Officine Electrochimiche Trentine, plants at Calusco and Trento	20
Lead	Societá Minerarie e Metallurgical di Pertusola S.p.A., mine at Salafossa and smelter at La Spezia, Penarroya France 76.3%	48
Mercury	Societá Mercurifera Monte Amiata S.p.A., mines at Morone, Bagni, S. Filippo, and Monte Civitella, Government 100%	100
Petroleum, crude	ENI, oilfield at Gela, offshore Sicily, Government 100%	100
Petroleum, refined	Mediterranea S.p.A., refinery at Milazzo, Esso	12
Do	Montedison S.p.A., refinery at Priolo, ENI	9
Do	Saras, refinery at Cagliari, ENI	8
Do	Sarpom Raffinazione S.p.A., refinery at Ravenna, British Petroleum	8
Do	Sarpom (Trecate) S.p.A., refinery at Novara, Standard Oil of California	6
Do	Esso Italiana S.p.A., refinery at Augusta, Sicily	5
Potash	Industria Sali Potassici e Affini (ISPEA), mines in Sicily, Italian Government and Sicilian Government	100
Pumice	Italpumice S.p.A., mine on Lipari Island, north of Sicily	90
Pyrite	Solmine S.p.A., mines at Campiano, Fenice, Capanne, and Gavorano, Government	90
Steel	Italsider S.p.A., iron and steel works at Taranto and Cornigliano, Government	55
Zinc	Societá Mineraria e Metallurgica di Pertusola S.p.A., mine at Salafosso and smelter at Grotone, Penarroya France 76.3%	51

Table 1.—Italy: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
METALS				
Aluminum:				
Bauxite		31,640	32,165	24,200
Alumina e		r 736,600	r 742,000	742,000
Metal:				
Primary		212,225	190,409	206,500
Secondary		209,000	151,000	198,000
Antimony:				
Mine output, metal content		r 1,177	1,010	1,015
Regulus		1,171	1,444	1,471
Cadmium, smelter output		529	409	435
Copper:				
Mine output, metal content		1,073	917	916
Metal, secondary only [1]		r 19,000	19,000	22,000
Germanium		56	NA	NA
Iron and steel:				
Iron ore and concentrate [2]	thousand tons	593	540	514
Pig iron	do	11,686	11,350	11,631
Ferroalloys:				
Blast furnace	do	75	61	65
Electric furnace	do	174	179	192
Crude steel	do	23,803	21,836	23,447
Steel, semimanufactures:				
Hot rolled:				
Wire rod	do	1,334	1,113	1,309
Sections	do	7,028	6,291	7,185
Plates and sheets	do	8,323	5,190	5,277
Hoop and strip	do	1,154	630	843
Railway track materials	do	150	199	234
Ingots, semimanufacturing and solid for tubes	do	1,163	1,110	3,470
Other	do	939	879	--
Total hot rolled	do	20,091	15,412	18,318
Castings and forgings	do	r 258	569	442
Cold-rolled sheet	do	3,986	2,418	3,920
Seamless tubes	do	900	851	806

See footnotes at end of table.

Table 1.—Italy: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS—Continued			
Lead:			
Mine output, metal content	r 22,989	28,990	29,395
Metal:			
Primary	r 46,042	33,197	46,013
Secondary	68,300	56,800	72,187
Magnesium metal, primary	r 7,431	6,344	7,033
Manganese:			
Mine output, gross weight	14,008	--	4,461
Mine output, metal content	r 3,782		1,204
Mercury metal, 76-pound flasks	r 26,020	31,677	22,278
Silicon, elemental	16,190	14,100	17,700
Silver metal, thousand troy ounces	1,344	1,157	1,543
Tin alloys	6,900	6,000	6,100
Zinc:			
Mine output, metal content	r 85,800	76,016	80,727
Metal, primary	r 184,215	179,732	191,221
NONMETALS			
Asbestos	148,099	146,980	164,788
Barite	180,470	212,868	179,107
Cement, hydraulic, thousand tons	36,309	34,235	36,327
Clays, crude:			
Bentonite, do	344	280	235
Refractory (excluding kaolinitic earth), do	353	251	234
For cement, do	5,483	NA	NA
For brick and terra cotta, do	33,517	NA	NA
Fuller's earth, do	105	70	25
Kaolin, do	90	78	82
Kaolinitic earth, do	23	28	27
Diatomite	31,715	e r 32,000	e 32,000
Feldspar	238,684	185,209	182,605
Fertilizer materials:			
Crude potassium salts, natural, thousand tons	1,944	1,834	1,696
Manufactured, gross weight:			
Nitrogenous, do	3,174	3,029	2,804
Phosphatic, do	1,138	783	817
Potassic, do	291	282	267
Mixed and unspecified, do	1,867	1,910	1,458
Fluorspar, all grades	248,491	231,253	210,812
Graphite, all grades	2,530	1,492	3,848
Gypsum (except dimension stone use), thousand tons	4,178	e r 4,200	e 4,200
Lime (quicklime and hydrated), do	2,320	2,185	2,188
Pigments, natural, crude	1,850	NA	NA
Pumice and related materials:			
Pumice and pumiceous lapilli, thousand tons	889	e r 900	e 900
Pozzolan, do	5,646	e r 5,700	e 5,700
Pyrite, all kinds:			
Gross weight, do	1,168	962	850
Sulfur content, do	r 507	414	366
Salt:			
Marine, crude, do	888	1,220	603
Other including brine, do	4,006	3,191	3,410
Sand and gravel:			
Calcareous sand, do	e 2,300	NA	NA
Silica sand, do	4,578	NA	NA
Volcanic sand, do	173	NA	NA
Other sand and gravel, do	119,425	NA	NA
Stone:			
Dimension stone:			
Calcareous:			
Alabaster and onyx, do	19	NA	NA
Gypsum for cutting, do	4,227	NA	NA
Limestone, do	46,627	NA	NA
Marble in blocks:			
White, do	1,034	NA	NA
Colored, do	1,218	NA	NA
Schist, do	64	NA	NA
Travertine, do	1,234	NA	NA
Tufa, do	5,226	NA	NA
Other:			
Diorite, do	5	NA	NA
Gneiss, do	339	NA	NA
Granite, do	367	NA	NA
Lava, basalt and trachyte, do	4,554	NA	NA
Porphyry, do	412	NA	NA
Quartz and quartzite, do	10	NA	NA
Sandstone, do	1,023	NA	NA
Serpentine, do	2,798	NA	NA
Slate, do	89	NA	NA
Tuff, volcanic, do	5,199	NA	NA

See footnotes at end of table.

Table 1.—Italy: Production of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS—Continued			
Stone—Continued			
Crushed and broken:			
Diabase ---thousand tons--	157	NA	NA
Dolomite ---do---	1,283	NA	NA
Limestone ---do---	47,249	NA	NA
Quartz and quartzite ---do---	481	NA	NA
Strontium minerals	750	e 720	e 700
Sulfur, native:			
Ore	473,301	500,296	349,082
Concentrate and filtrate (85% to 90% sulfur)	64,868	43,967	34,623
Fused in briquets	16,326	20,227	13,412
Talc and related materials	154,965	144,082	153,836
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bituminous rock, natural:			
For distillation	36,919	57,099	54,299
For paving	105,697	103,988	76,177
Carbon black	151,544	136,381	155,234
Coal:			
Subbituminous (sulcis coal) ---thousand tons--	4	2	1
Lignite ---do---	1,960	2,063	2,028
Coke, metallurgical ---do---	8,566	8,114	7,970
Gas, natural, marketed production ---million cubic feet--	540,364	514,252	552,336
Natural gas liquids, natural gasoline thousand 42-gallon barrels--	585	408	405
Petroleum:			
Crude ---do---	6,976	6,934	7,553
Refinery products:			
Gasoline:			
Aviation ---do---	788	571	376
Motor ---do---	124,959	119,136	122,363
Jet fuel ---do---	14,388	11,202	12,920
Kerosine ---do---	30,727	23,161	26,760
Distillate fuel oil ---do---	223,038	179,659	200,527
Residual fuel oil ---do---	341,046	282,428	289,148
Lubricants ---do---	4,524	3,694	4,795
Other:			
Refinery gas ---do---	4,761	3,193	3,227
Liquefied petroleum gas ---do---	25,898	25,071	27,061
Naphtha ---do---	72,203	48,159	55,612
Paraffin ---do---	50	47	165
Bitumen ---do---	11,035	10,696	10,288
Unspecified ---do---	2,224	1,532	1,412
Partly refined oil ---do---	31,615	27,655	31,232
Refinery fuel and losses ---do---	48,820	43,628	47,145
Total ---do---	936,076	779,832	833,031

e Estimate. p Preliminary. r Revised. NA Not available.
[1] Includes secondary blister used chiefly for production of copper sulfate and other chemical uses.
[2] Excludes pelletized iron oxide derived from pyrite.

TRADE

Imports of minerals and fuels were valued at $16 billion or approximately 40% of the country's total imports in 1975, the latest year for which complete data were available. Imports of fuels accounted for 64% of the mineral imports. The Netherlands and the U.S.S.R. provided most of the natural gas. Saudi Arabia, Iran, and Libya were major sources of crude oil. Mineral and fuel exports, chiefly refined petroleum and other processed minerals, were valued at about $5 billion or 17% of total exports. Tables 2 and 3 show foreign trade of Italy for selected minerals and fuels.

Table 2.—Italy: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite	5,256	5,912	Yugoslavia 2,561.
Oxide and hydroxide	252,645	364,195	Netherlands 223,236; U.S.S.R. 49,903.
Ash and residue containing aluminum	3,275	3,783	France 2,096; West Germany 1,468.
Metal including alloys:			
Scrap	734	223	NA.
Unwrought	23,327	33,829	West Germany 22,730; Turkey 5,882.
Semimanufactures	61,400	58,235	France 14,685; West Germany 8,703.
Antimony metal, all forms (including waste and scrap)	717	1,108	Netherlands 332; United States 175.
Arsenic:			
Natural sulfides	1	NA	
Trioxide, pentoxide, acids	70	25	NA.
Beryllium oxide and hydroxide	NA	3	NA.
Bismuth metal	31	11	Netherlands 7.
Cadmium metal including alloys, all forms	51	102	West Germany 80; East Germany 20.
Chromium:			
Chromite	1,595	3,811	France 1,962; Austria 824.
Oxide and hydroxide	319	1,020	Australia 288; Sweden 137.
Metal including alloys, all forms	7	17	NA.
Cobalt:			
Oxide and hydroxide	26	NA	
Metal including alloys, all forms	11	4	NA.
Columbium and tantalum:			
Ore and concentrate	70	NA	
Metal, all forms (including waste and scrap)	4	32	United States 4.
Copper:			
Ore and concentrate	4,032	2,961	Spain 1,826; Sweden 800.
Matte	937	741	Austria 564.
Ash and residue containing copper	5,781	10,141	West Germany 9,155.
Copper sulfate	161	319	NA.
Metal including alloys:			
Scrap	4,882	3,249	West Germany 2,698.
Unwrought	9,747	6,072	West Germany 2,538; Romania 2,042.
Semimanufactures	48,076	52,715	West Germany 11,214; France 10,814.
Gallium, indium, and thallium ---kilograms	52,000	11,000	Switzerland 1,000.
Germanium ---do	3,800	5,000	NA.
Iron and steel:			
Ore and concentrate	17,908	12,055	West Germany 3,363.
Roasted pyrite ---thousand tons	242	224	Austria 143; France 58.
Metal:			
Scrap ---do	11	5	West Germany 3; France 2.
Pig iron including cast iron, spiegeleisen, powder and shot ---do	12	8	United Kingdom 2; West Germany 1; Netherlands 1; Switzerland 1.
Ferroalloys ---do	28	27	West Germany 8; France 3; Belgium-Luxembourg 2; Austria 2; Sweden 2.
Steel, primary forms ---do	447	964	Brazil 221; Spain 102.
Semimanufactures:			
Bars, rods, angles, shapes, sections ---do	2,050	1,958	West Germany 405; Libya 294; France 255.
Universals, plates, sheets ---do	809	1,394	United States 290; West Germany 157.
Hoop and strip ---do	85	88	Greece 16; Yugoslavia 11; France 10; Romania 8.
Rails and accessories ---do	29	37	Poland 17; Switzerland 6; Iraq 3; Brazil 3.
Wire ---do	49	41	Libya 6; France 5.
Tubes, pipes, fittings ---do	1,274	1,780	U.S.S.R. 541; Egypt 205.
Castings and forgings, rough ---do	53	48	Yugoslavia 8; Cuba 4; Ghana 4.
Total ---do	4,349	5,346	

See footnotes at end of table.

Table 2.—Italy: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Lead:			
Ore and concentrate	12,529	20,017	Austria 6,207; Greece 5,045; Tunisia 2,350; Netherlands 2,197; Yugoslavia 2,117.
Ash and residue containing lead	3,996	350	United Kingdom 120.
Oxide	429	728	Yugoslavia 631.
Metal including alloys:			
Scrap	43	191	NA.
Unwrought	1,577	3,529	Austria 1,720; Turkey 525.
Semimanufactures	795	1,241	Libya 939.
Lithium	(1)	NA	
Magnesium metal including alloys:			
Scrap	518	633	West Germany 220; France 212.
Unwrought	6,067	4,221	West Germany 3,393.
Semimanufactures	215	172	France 72.
Manganese:			
Ore and concentrate	82	33	NA.
Oxide and hydroxide	227	81	Tunisia 30.
Metal, all forms	NA	24	NA.
Mercury ---76-pound flasks--	17,187	49,459	East Germany 12,125; United States 6,643; West Germany 5,918; Belgium-Luxembourg 5,512.
Molybdenum metal including alloys, all forms ---kilograms--	7,200	3,000	NA.
Nickel:			
Matte, speiss, similar materials	297	23	NA.
Metal including alloys:			
Unwrought	570	413	West Germany 250; France 77.
Semimanufactures	944	1,109	Spain 257; Qatar 230; West Germany 195; Morocco 122.
Platinum-group metals and silver including alloys:			
Platinum group --thousand troy ounces--	62	58	West Germany 35; France 10.
Silver ---do---	3,787	1,447	France 257; West Germany 161; Belgium-Luxembourg 161.
Rare-earth metals:			
Oxides and other compounds ---value--	$511	$202	United Kingdom $201.
Metals, cerium	(1)	13	NA.
Selenium, elemental ---kilograms--	1	700	NA.
Silicon, elemental	1,890	7,134	West Germany 1,495; Poland 718.
Thorium:			
Ore and concentrate ---kilograms--	24	NA	
Thoria ---value--	$3,312	(1)	NA.
Tin:			
Oxide	22	186	Poland 100; France 54.
Metal, all forms	650	558	France 169; Netherlands 142; Denmark 75; West Germany 68.
Titanium:			
Ore and concentrate	34	15	NA.
Oxides	22,748	18,498	Poland 2,440; France 2,341; West Germany 1,986.
Metal including alloys, all forms	48	48	France 36.
Tungsten metal including alloys, all forms	40	27	West Germany 5.
Vanadium oxide and hydroxide --kilograms--	5,200	NA	
Zinc:			
Ore and concentrate	15	10,339	Belgium-Luxembourg 8,804; Spain 1,530.
Ash and residue containing zinc	7,515	6,602	West Germany 5,811.
Oxide	2,679	1,343	France 662; Cuba 170.
Metal including alloys:			
Scrap	137	703	Turkey 120.
Blue powder	r 646	890	Romania 465.
Unwrought	22,532	30,013	United States 16,226.
Semimanufactures	1,010	624	Yugoslavia 111.
Zirconium:			
Ore and concentrates	80	21	NA.
Metal including alloys, all forms	2	2	All to United States.
Other:			
Ore and concentrate	38	17	West Germany 9; Belgium-Luxembourg 6.
Ash and residue containing nonferrous metals, n.e.s	4,679	3,552	West Germany 2,620; France 498.
Oxides and hydroxides	163	373	Netherlands 35; France 31.

See footnotes at end of table.

Table 2.—Italy: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Other—Continued			
Metal including alloys, all forms:			
Metalloids, n.e.s	2,745	1,300	United Kingdom 429; Denmark 374; France 311.
Alkali, alkaline-earth and rare-earth metals, n.e.s	140	41	NA.
Pyrophoric alloys	NA	1	NA.
Base metals including alloys, all forms, n.e.s	1	7	NA.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, corundum, etc	203,321	129,811	United Kingdom 58,840; Algeria 38,293.
Dust and powder of precious and semiprecious stones ----value	$4,664	$39	NA.
Grinding and polishing wheels and stones	11,499	10,869	France 1,366.
Asbestos	66,784	81,073	West Germany 22,534; France 12,568.
Barite and witherite	17,431	16,079	Netherlands 5,000; Egypt 4,420; Algeria 3,000.
Boron materials:			
Crude natural borates	146	40	NA.
Oxide and acid	4,064	2,644	West Germany 1,179; France 561.
Cement ----thousand tons	691	744	Israel 257; Libya 137; Yugoslavia 128.
Chalk	888	779	NA.
Clays and clay products (including all refractory brick):			
Crude, n.e.s.:			
Bentonite	22,503	19,061	Libya 8,911; United Kingdom 1,534.
Kaolin	47,789	40,917	France 30,515.
Other	8,972	7,350	NA.
Products:			
Refractory (including nonclay bricks)	86,380	84,998	West Germany 10,707.
Nonrefractory ----thousand tons	1,148	1,041	France 256; West Germany 239.
Cryolite and chiolite	1,517	(1)	NA.
Diamond:			
Gem, not set or strung -value, thousands	$7	$7	NA.
Industrial ----do	$59	$27	NA.
Diatomite and other infusorial earth	1,272	1,441	Cuba 196.
Feldspar	33,420	22,539	West Germany 8,202.
Fertilizer materials:			
Crude	7,990	6,610	France 4,278; Libya 1,784.
Manufactured:			
Nitrogenous ----thousand tons	1,349	720	India 137; Egypt 110; People's Republic of China 93.
Phosphatic ----do	6	24	Indonesia 20; Libya 2.
Potassic ----do	29	68	Greece 11; Republic of Korea 11.
Other ----do	286	154	India 72.
Ammonia	33,714	63,332	Greece 40,132; Spain 11,542.
Fluorspar	75,511	84,416	United States 27,600; West Germany 26,040.
Graphite, natural	2,673	1,792	France 880.
Gypsum and plasters	26,287	10,559	France 2,448.
Lime	134,980	94,401	Libya 67,443; Switzerland 23,399.
Lithium ore	8,900	5	NA.
Magnesite	342	212	NA.
Mica:			
Crude, including splittings and waste	602	499	NA.
Worked, including agglomerated splittings	61	65	NA.
Pigments, minerals including processed iron oxides	1,673	1,935	Libya 667; East Germany 309.
Precious and semiprecious stones except diamond:			
Natural ----value, thousands	$60	$25	NA.
Manufactured ----kilograms	427	155	NA.
Pyrite (gross weight)	54,696	40,314	Switzerland 31,794; Austria 6,549.
Salt, all forms	70,840	59,453	Denmark 5,000.
Sodium and potassium compounds:			
Caustic soda	352,166	300,240	Yugoslavia 76,869; U.S.S.R. 43,316.
Caustic potash	708	869	Switzerland 459.

See footnotes at end of table.

Table 2.—Italy: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	296,707	257,261	Libya 37,914; Spain 37,545; Lebanon 25,671.
Slate	3,064	2,622	NA.
Other	93,284	76,352	West Germany 29,223; Switzerland 17,445; Austria 11,193.
Worked, all forms	853,833	697,355	West Germany 341,897; France 105,931.
Dolomite, all forms	30,756	22,437	Switzerland 5,455; Argentina 3,017; Austria 2,756.
Gravel and crushed rock	642,550	531,968	West Germany 115,095; Libya 101,094.
Limestone (except dimension)	1,852	67	NA.
Quartz and quartzite:			
Piesoelectric crystal ---kilograms	5,540	13,100	NA.
Other	40,390	41,576	Switzerland 23,701; France 10,140.
Sand, excluding metal bearing	617,903	305,279	Switzerland 253,254.
Sulfur:			
Elemental, all forms	7,021	4,954	Yugoslavia 2,628.
Sulfur dioxide	59	96	NA.
Sulfuric acid	89,991	151,615	Turkey 70,701; Greece 31,408.
Talc, steatite, soapstone	53,772	41,959	West Germany 12,178; United States 7,982; United Kingdom 7,012.
Other:			
Slag, dross and similar waste, not metal bearing	249,236	317,327	Yugoslavia 265,509.
Oxides, hydroxides, and peroxides of magnesium, strontium and barium	5,370	1,962	United States 586.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	78,749	105,929	Libya 35,271; France 28,921.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	968	1,692	Libya 863.
Carbon black and gas carbon	33,986	33,573	Austria 6,910; Yugoslavia 6,354; Greece 3,607.
Coal, all grades (including briquets)	10,338	4,253	Switzerland 2,646; Malta 620; Argentina 618.
Coke and semicoke	712,991	796,979	Romania 270,929; Spain 154,832; Algeria 98,966.
Peat	269	267	NA.
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	49,019	31,654	United Kingdom 6,282; Netherlands 5,330.
Kerosine ---do---	21,413	16,159	Greece 2,007; Libya 1,589.
Distillate fuel oil ---do---	62,887	45,848	West Germany 7,618; Switzerland 6,533.
Residual fuel oil ---do---	63,369	39,407	United States 6,200.
Lubricants ---do---	1,837	3,251	Belgium-Luxembourg 306; Netherlands 253.
Other:			
Liquefied petroleum gas ---do---	3,836	3,828	Egypt 1,148; Spain 719; Turkey 626.
Mineral jelly and wax ---do---	6	8	NA.
Bitumen and other residues ---do---	990	1,127	Austria 527; Switzerland 424.
Bituminous mixtures, n.e.s ---do---	85	79	Malta 36.
Petroleum coke and pitch coke ---do---	280	138	France 61; Greece 50; Yugoslavia 22.
Total ---do---	203,722	141,499	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	71,090	125,650	France 88,481; Netherlands 17,803.

r Revised. NA Not available.
1 Less than ½ unit.

Table 3.—Italy: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite	5,256	1,829,887	Australia 1,440,265; Guinea 207,844.
Ash and residue containing aluminum	42,915	35,218	Austria 20,213; France 5,544.
Oxide and hydroxide	67,465	66,427	France 25,018; Australia 23,555; West Germany 10,560.
Metals including alloys:			
Scrap	65,586	33,465	West Germany 8,363; France 6,567; Switzerland 6,018; Austria 4,235.
Unwrought	256,065	130,904	France 25,513; Netherlands 22,917; Greece 20,387; West Germany 19,090.
Semimanufactures	70,251	36,555	West Germany 13,013; France 10,057; United States 4,442.
Antimony:			
Ore and concentrate	2,326	728	Canada 675.
Metal including alloys, all forms	112	184	Belgium-Luxembourg 86.
Arsenic trioxide, pentoxide and acids	1,352	1,531	France 671; People's Republic of China 436.
Beryllium metal including alloys, all forms—kilograms	5,600	3,400	NA.
Bismuth metal including alloys, all forms	156	159	France 84; West Germany 31.
Cadmium	129	143	Mexico 46.
Chromium:			
Chromite	149,854	160,728	Turkey 60,705; Albania 34,608; U.S.S.R. 26,610; Republic of South Africa 25,022.
Oxide and hydroxide	2,064	2,001	West Germany 1,130.
Metal including alloys, all forms	208	143	West Germany 51; United Kingdom 50.
Cobalt:			
Oxide and hydroxide	398	314	Belgium-Luxembourg 217; France 42.
Metal including alloys, all forms	512	282	Belgium-Luxembourg 97; France 50; Zambia 44; United States 33.
Columbium and tantalum:			
Ore and concentrate	544	235	All from Canada.
Metal, all forms (including waste and scrap)	36	25	United States 4; West Germany 3.
Copper:			
Matte	183	NA	
Ash and residue containing copper	3,711	277	NA.
Copper sulfate	4,851	1,944	Yugoslavia 814; France 577; United Kingdom 309.
Metal including alloys:			
Scrap	66,388	55,940	United States 15,606; France 11,367; West Germany 10,620; United Kingdom 9,499.
Unwrought	340,445	299,179	Zambia 73,870; Chile 62,738; Zaire 60,773.
Semimanufactures	34,311	26,483	West Germany 10,777; Belgium-Luxembourg 6,584.
Gallium, indium, thallium—kilograms	800	1,300	NA.
Germanium—do	40,200	800	Belgium-Luxembourg 300.
Iron and steel:			
Ore and concentrate—thousand tons	18,133	15,650	Brazil 3,094; Liberia 2,831; Venezuela 2,161; Australia 2,084; U.S.S.R. 1,686.
Roasted pyrite—do	78	1	All from West Germany.
Metal:			
Scrap—do	6,277	5,414	France 2,281; West Germany 1,739.
Pig iron including cast iron and spiegeleisen—do	1,039	662	West Germany 174; France 106; Sweden 87; U.S.S.R. 87; Algeria 68.
Sponge iron, powder, shot—do	26	15	France 6; Sweden 6; Spain 2.
Ferroalloys:			
Ferromanganese—do	154	125	France 56; Republic of South Africa 39.
Other—do	165	120	Norway 21; France 19; Republic of South Africa 19; West Germany 14.
Steel, primary forms—do	1,783	1,481	France 476; West Germany 237; Japan 184.

See footnote at end of table.

Table 3.—Italy: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures:			
Bars, rods, angles, shapes, sections ----thousand tons--	900	468	France 168; West Germany 89; Austria 54.
Universals, plates, sheets do----	1,557	1,054	France 316; Belgium-Luxembourg 153; West Germany 133.
Hoop and strip -------do----	231	152	France 60; Belgium-Luxembourg 32; West Germany 31.
Rails and accessories --do----	122	77	West Germany 39; France 22.
Wire ----------do----	84	40	Belgium-Luxembourg 18; West Germany 10; France 5.
Tubes, pipes, fittings --do----	274	189	West Germany 68; France 46.
Castings and forgings, rough do----	10	4	West Germany 1; France 1; Yugoslavia 1.
Total ----------do----	3,178	1,984	
Lead:			
Ore and concentrate ----------	61,144	13,616	Canada 9,847; Greece 3,648.
Ash and residue containing lead -----	1,802	809	Canada 546.
Oxide ----------	15,458	3,391	Mexico 2,291; Bulgaria 358.
Metal including alloys:			
Scrap ----------	29,229	18,531	West Germany 4,693; France 4,025; Switzerland 2,641.
Unwrought ----------	164,655	129,511	West Germany 29,085; Mexico 27,890; Peru 15,147.
Semimanufactures ----------	833	640	Yugoslavia 201; West Germany 153; France 142.
Lithium ----------	8	14	NA.
Magnesium metal including alloys:			
Scrap ----------	1,501	795	West Germany 557.
Unwrought ----------	1,153	230	West Germany 70.
Semimanufactures ----------	132	145	United States 48; United Kingdom 31.
Manganese:			
Ore and concentrate ----------	308,072	315,382	Republic of South Africa 146,271; Gabon 106,236; Brazil 35,413.
Oxides ----------	2,720	3,919	Belgium-Luxembourg 867; Japan 472.
Metal, all forms ----------	2,770	1,921	Republic of South Africa 1,269; France 424.
Mercury ----------76-pound flasks--	4,314	261	People's Republic of China 203.
Molybdenum:			
Ore and concentrate ----------	8,439	6,229	Netherlands 4,370.
Metal including alloys, all forms ----	79	92	Austria 46; France 11; Netherlands 11.
Nickel:			
Matte, speiss and similar materials --	4,622	4,907	Canada 4,109; Cuba 496.
Metals including alloys:			
Scrap ----------	1,609	833	Canada 524.
Unwrought ----------	15,441	7,068	United Kingdom 2,078; Norway 1,092; Republic of South Africa 1,062.
Semimanufactures ----------	3,796	2,324	West Germany 787; United Kingdom 494; United States 445; France 235.
Platinum-group metals and silver including alloys:			
Platinum group_thousand troy ounces--	188	434	West Germany 282; France 65.
Silver ----------do----	43,976	29,096	United States 7,427; West Germany 4,147; United Kingdom 4,115.
Rare-earth metals:			
Oxides and other compounds value, thousands--	$502	$318	France $278.
Metals:			
Cerium ----------	288	4	NA.
Other ----------	414	313	West Germany 261; Austria 50.
Selenium, elemental ----------	35	25	Japan 13; West Germany 8.
Silicon, elemental ----------	8,951	2,804	France 1,230; Republic of South Africa 813.
Tellurium and arsenic ----------	68	208	West Germany 79; Sweden 57; Canada 22.

See footnote at end of table.

Table 3.—Italy: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Thorium ----------value--	$45	$44	NA.
Tin:			
Oxide ----------	54	35	NA.
Metal including alloys:			
Scrap ----------	39	1	NA.
Unwrought ----------	11,241	6,082	Malaysia 4,005.
Semimanufactures ----------	311	138	West Germany 54; Belgium-Luxembourg 31.
Titanium:			
Ore and concentrate ----------	277,033	102,929	Norway 94,663.
Oxides ----------	41,233	26,049	West Germany 9,644; France 7,163; Netherlands 3,612; Belgium-Luxembourg 2,841.
Metal including alloys, all forms ----	1,973	2,195	Austria 825; United States 653; U.S.S.R. 354.
Tungsten:			
Ore and concentrate ----------	277	240	People's Republic of China 135; Portugal 40; West Germany 25.
Metal including alloys, all forms -----	90	63	France 11; Sweden 7.
Uranium metal ----------	8	5	NA.
Vanadium oxide and hydroxide ----------	588	527	Austria 244; West Germany 130; Netherlands 127.
Zinc:			
Ore and concentrate ----------	300,794	193,940	Canada 66,334; Peru 52,288.
Ash and residue containing zinc ------	2,715	1,646	Switzerland 1,309.
Oxide and hydroxide ----------	4,321	1,828	West Germany 621; France 310.
Metal including alloys:			
Scrap ----------	45,021	2,971	West Germany 1,406; France 711; Switzerland 462.
Blue powder ----------	1,613	1,752	West Germany 1,073; Belgium-Luxembourg 593.
Unwrought ----------	22,532	46,816	West Germany 11,642; Belgium-Luxembourg 10,761; Zambia 5,929.
Semimanufactures ----------	4,930	3,900	Belgium-Luxembourg 1,750; West Germany 1,383.
Zirconium:			
Ore and concentrate ----------	32,858	34,530	Australia 30,550.
Metal including alloys, all forms kilograms--	108,700	10,700	United States 6,600; France 600.
Other:			
Ore and concentrate ----------	9,230	8,709	Canada 2,918; Greece 2,000; Turkey 1,880; Australia 1,296.
Ash and residue containing nonferrous metals, n.e.s ----------	5,877	4,146	Switzerland 1,138.
Oxides and hydroxides ----------	4,498	4,404	Cuba 1,710; West Germany 951; France 467.
Metals including alloys, all forms:			
Metalloids ----------	82	101	United States 100.
Alkali, alkaline-earth and rare-earth metals, n.e.s --------	6,075	5,365	West Germany 3,472; France 1,495.
Pyrophoric alloys ----------	17	10	NA.
Base metals including alloys, all forms, n.e.s ----------	6	4	NA.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, etc ----------	3,210	2,393	West Germany 414.
Dust and powder of precious and semiprecious stones value, thousands--	$6,324	$8,017	Zaire $3,230; United States $2,795; Netherlands $1,024.
Grinding and polishing wheels and stones ----------	11,499	3,551	Austria 1,077; United Kingdom 572; West Germany 509.
Asbestos ----------	66,164	66,273	Republic of South Africa 32,507; Canada 12,851; U.S.S.R. 10,287.
Barite and witherite ----------	24,840	9,055	France 4,793; Spain 1,950; People's Republic of China 1,742.
Boron materials:			
Crude and natural borates ----------	167,401	147,648	Turkey 120,957; United States 18,604.
Oxide and acid ----------	272	180	NA.
Cement ----------	690,854	59,282	France 39,763; Yugoslavia 7,142.
Chalk ----------	11,808	12,958	France 11,935.

See footnote at end of table.

Table 3.—Italy: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Clays and clay products:			
Crude clays, n.e.s.:			
Bentonite	26,842	23,418	Greece 17,895.
Kaolin	736,478	430,842	United Kingdom 231,586; United States 102,844.
Other	861,536	595,119	France 322,093; West Germany 187,918; United Kingdom 71,928.
Products:			
Refractory	86,308	183,322	West Germany 41,727; France 31,771; Austria 30,406.
Nonrefractory	1,148,000	21,221	West Germany 15,264; France 4,088.
Cryolite and chiolite	403	317	Denmark 275.
Diamond:			
Gem, not set or strung value, thousands	$23,683	$9,129	Belgium-Luxembourg $5,657.
Industrial ——do	$4,467	$3,488	Belgium-Luxembourg $1,764; West Germany $863; Netherlands $435.
Diatomite and other infusorial earth	6,606	2,973	NA.
Feldspar	21,099	18,708	Norway 10,835; West Germany 2,816.
Fertilizer materials:			
Crude ——thousand tons	2,155	1,668	Morocco 1,208; United States 207.
Manufactured:			
Nitrogenous	152,280	60,314	West Germany 29,435; France 16,103.
Phosphatic	85,580	177,870	France 44,117; United States 39,586; Tunisia 28,865; Spain 23,324.
Potassic	363,788	273,437	Israel 76,892; U.S.S.R. 68,582; France 48,486; East Germany 48,364.
Other	94,305	311,172	United States 273,846.
Ammonia	42,087	39,412	Austria 15,274; Israel 9,499; East Germany 7,842.
Fluorspar	67,465	36,066	Mexico 17,289; France 13,171; Tunisia 5,553.
Graphite, natural	5,475	3,287	West Germany 1,589.
Gypsum and plasters	3,710	8,997	United States 1,289.
Lime	20	99	NA.
Lithium ore	378	772	Republic of South Africa 485.
Magnesite	76,693	58,740	Greece 21,524; Austria 8,699; Ireland 8,659; Netherlands 6,589.
Mica:			
Crude including splittings and waste	1,458	955	Republic of South Africa 209.
Worked including agglomerated splittings	415	296	France 99; Czechoslovakia 34; Belgium-Luxembourg 34.
Pigments, mineral, iron oxides	29,078	11,782	West Germany 6,658; India 1,142.
Precious and semiprecious stones except diamond:			
Natural ——value, thousands	$569	$409	NA.
Manufactured ——kilograms	20,588	8,163	Switzerland 3,046; France 1,646.
Pyrite (gross weight) ——thousands tons	293	317	Cyprus 166; U.S.S.R. 146.
Salt	49,589	41,212	Tunisia 21,956.
Sodium and potassium compounds	98,615	90,041	France 34,945; West Germany 25,505; Belgium-Luxembourg 15,772.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous including marble	172,119	116,812	Portugal 29,510; Yugoslavia 29,435; Iran 12,252.
Slate	2,003	1,887	NA.
Other	196,430	160,768	Republic of South Africa 45,158; Norway 21,201; Sweden 16,142; Brazil 16,131.
Worked, all forms	2,741	1,708	Belgium-Luxembourg 288; France 282.
Dolomite	2,214	1,431	NA.
Gravel and crushed rock	12,692	8,537	NA.
Limestone (except dimension)	1,103	78	NA.

See footnote at end of table.

Table 3.—Italy: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Stone, sand and gravel—Continued			
Quartz and quartzite:			
Piezoelectric crystal --kilograms--	35	75	NA.
Other	94,550	58,937	Switzerland 27,122; Portugal 18,454; West Germany 7,917.
Sand excluding metal bearing thousand tons--	1,301	976	France 515; Belgium-Luxembourg 341.
Sulfur:			
Elemental, all forms	766,257	559,291	Canada 330,052; Poland 85,047; Mexico 60,640; United States 58,615.
Sulfuric acid	52,956	47,793	United Kingdom 14,810; Poland 14,556.
Talc, steatite, soapstone, pyrophyllite	25,357	14,667	Austria 8,589; France 2,893.
Other:			
Slag, dross and similar waste, not metal bearing	42,047	24,602	France 5,585; Austria 5,249; Bulgaria 4,363.
Oxides and hydroxides of strontium, barium and magnesium	2,989	3,628	West Germany 800; United States 360.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	26,267	18,615	Canada 3,903; France 3,814; United States 3,116; Belgium-Luxembourg 2,490; Austria 1,962.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen	1,424	1,891	United States 1,362.
Carbon black and gas carbon	22,263	17,606	France 5,916; West Germany 4,987; Netherlands 4,129.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	12,208	12,314	United States 4,058; West Germany 3,025; Poland 2,803.
Briquets of bituminous coal and anthracite ---do---	38	17	West Germany 12; France 4.
Lignite and lignite briquets ---do---	148	68	Yugoslavia 34; West Germany 28.
Coke and semicoke ---do---	124	155	France 56; West Germany 45; United Kingdom 27; Mexico 16.
Gas, natural, liquefied -million cubic feet--	72,830	400,023	Netherlands 194,085; U.S.S.R. 86,425.
Peat ---thousand tons--	32	26	U.S.S.R. 10; West Germany 9; Poland 3.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels--	884,902	661,101	Saudi Arabia 190,363; Iraq 133,091; Iran 90,832; Libya 89,423.
Refinery products:			
Gasoline ---do---	6,737	13,974	U.S.S.R. 6,129; Egypt 1,836.
Kerosine ---do---	776	1,023	Libya 364; Trinidad and Tobago 295; Greece 140; United Kingdom 116.
Distillate fuel oil ---do---	6,387	7,487	U.S.S.R. 4,715; France 1,306.
Residual fuel oil ---do---	24,589	52,394	U.S.S.R. 9,850; Greece 8,365; Venezuela 5,681.
Lubricants ---do---	1,296	899	United States 186; France 186; West Germany 153; United Kingdom 147.
Other:			
Liquefied petroleum gas-do---	14,890	71,147	Netherlands 34,568; Libya 18,906.
Mineral jelly and wax -do---	481	346	West Germany 102; Hungary 71; U.S.S.R. 39.
Bitumen and other residues do---	1,870	1,479	United States 618; Albania 600.
Bituminous mixtures, n.e.s do---	38	30	France 18.
Petroleum coke and pitch do---	3,484	3,691	United States 2,877.
Total ---do---	60,548	152,470	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	122,441	193,399	United States 105,638; Spain 24,979; Romania 24,240.

NA Not available.

COMMODITY REVIEW

METALS

Aluminum.—Domestic output of aluminum was dependent on imported bauxite, but metal production was also below demand, and imports of aluminum were essential for the Italian manufacturing industry. Aluminum output came from plants at Porto Vesme, operated by Societá dell Aluminio in Sardegna (Alsar); at Bolzano, Fusina, and Mori, operated by Alummetal; Fusina and Porto Marghera, operated by Societá Aluminio Veneto per Azioni S.p.A. (SAVA); and Borgo-Franco d'Ivrea, operated by Alcan Italiano S.p.A. The aggregated capacity of the aluminum smelters was 340,000 tons. About two-thirds of the total aluminum supply was used by the automobile manufacturing, construction, and appliance industries.

Antimony.—During 1976, no major events were reported in the antimony industry of Italy. Antimony ore was mined at the Tafone mine near Grosseto. Domestic and imported stibnite ores were processed to regulus at the Azienda Minerali Metallici Italiane S.p.A. (AMMI) smelter near Manciano.

Iron and Steel.—Depressed economic conditions kept operations of the iron and steel industry at modest levels and without new developments that would significantly affect future performance of the industry. During 1976, Italy remained dependent on imports of iron ore, scrap, and some pig iron to meet the demand of its steel industry, which was among the largest in Europe. On Elba, domestic iron ore, averaging about 44% Fe, was produced at opencast and underground mines operated by Italsider S.p.A., but output was not significant, amounting to only about 3% of annual consumption. In addition, ferrogenous sand was dredged from waters 10 to 15 meters deep in the northern part of the island.

Italsider remained the principal producer of iron and steel. The company is headquartered in Genoa and has plants in Taranto, Bagnoli, Cornigliano, Campi-Corso, Novi Ligure, Trieste, Maghera, San Giovani Valdarno, Lovere, and Savona. Dalmine of Milan and Fiat S.p.A. of Turin were other leading producers. Salient statistics for iron and steel are shown in table 4.

Lead and Zinc.—Domestic mine and smelter output of lead and zinc was below domestic demand, nevertheless, output and consumption of lead and zinc metals continued high in spite of the economic slowdown.

At the Massua mine, operated by AMMI Sarda, exploration led to delineation of a new ore body with proven reserves of 10 million tons of ore with an average content of 4% zinc and 1% lead. The bismuth, cadmium, and silver content of the ores was not announced. In addition, expansion of the flotation plant to a capacity of 1,000 tons per day was completed. At mines operated by Societá Piombo Zincifera Sarda, studies were conducted to resolve the problem of tailings disposal into the sea, and work was underway to concentrate production in the Carolina shaft.

At AMMI's Raibli mine, located north of Udine and near the Yugoslav border, a new ore body with 500,000 tons of proven reserves was discovered and delineated; average aggregated metal content was 9.5% lead and zinc oxide.

At the Salafossa mine, located in northeastern Italy near the Austrian border and operated by Societá Mineraria e Metallurgica di Pertusola, exploratory activities led to discovery of a new ore body with reserves of about 300,000 tons. Grade of ore was not made public.

Largest producers of lead and zinc metals were AMMI Sarda with a smelter at Porto Vesme, and Pertusola with smelters at La Spezia and Crotone.

In the Porto Vesme lead and zinc smelter, construction of a briqueting plant for concentrates of oxide ores for the Waelz kiln, and of a new sulfuric acid plant was completed.

At the Crotone zinc electrolytic plant, work was underway to increase annual capacity from 90,000 tons to 130,000 tons. Completion was scheduled for 1978–81. Capacity of AMMI's lead refinery at San Gavino will be 43,000 tons of refined lead in 1978, when present expansion work is expected to be completed.

Other Metals.—Italy produced a variety of metals. Cadmium and silver were produced as byproducts of lead and zinc production in Sardinia and the northeastern part of Italy.

Table 4.—Italy: Salient statistics on iron and steel production

(Thousand metric tons)

Year	Pig iron			Ferro-alloys	Crude steel					Hot-rolled steel [2]	Iron rolled from rerolled scrap	Other finished products [3]
	Blast furnace	Electric furnace	Total [1]		Open-hearth furnace	Electric furnace	Converter	Other	Total [1]			
1955	1,371	253	1,625	r 105	3,052	2,141	355	--	5,548	4,000	26	180
1956	1,643	230	1,873	120	3,372	2,370	334	--	6,076	4,416	21	185
1957	1,842	230	2,072	135	3,896	2,704	380	--	6,979	5,014	107	201
1958	1,838	222	2,060	107	3,612	2,501	336	--	6,449	4,635	119	172
1959	1,886	212	2,098	94	3,751	2,803	399	--	6,954	5,084	119	164
1960	2,378	310	2,688	141	4,601	3,412	449	--	8,462	6,484	147	209
1961	2,771	285	3,056	145	4,986	3,765	632	--	9,383	7,043	155	242
1962	3,307	249	3,556	122	5,160	3,960	637	1	9,757	7,386	161	242
1963	3,508	232	3,741	127	5,266	4,235	655	1	10,157	7,835	145	227
1964	3,249	249	3,498	127	4,886	4,226	680	1	9,793	7,617	124	201
1965	5,252	237	5,490	141	5,146	4,745	2,789	2	12,681	9,780	89	208
1966	6,082	177	6,259	158	4,955	4,970	3,711	3	13,639	10,329	74	230
1967	7,052	242	7,294	170	5,618	5,997	4,272	3	15,890	12,156	78	299
1968	7,619	207	7,826	168	5,665	6,427	4,869	3	16,964	13,248	75	320
1969	7,542	238	7,781	167	5,204	6,554	4,666	4	16,428	13,353	66	333
1970	8,109	222	8,332	197	4,841	6,994	5,438	5	17,277	13,929	68	361
1971	8,411	125	8,536	191	3,999	7,073	6,375	5	17,452	13,969	65	328
1972	9,347	68	9,415	219	3,988	8,075	7,745	6	19,815	15,342	66	281
1973	9,976	57	10,033	238	3,628	8,633	8,728	7	20,995	17,288	74	293
1974	11,623	62	11,686	249	3,511	9,860	10,424	8	23,803	19,153	75	291
1975	11,293	58	11,350	240	2,456	9,381	9,991	8	21,836	16,824	49	NA
1976	11,610	20	11,630	257	1,956	10,819	10,664	8	23,447	18,910	80	NA

[1] Data may not add to totals shown because of independent rounding.
[2] Rolled steel structurals: plates, sheets, tin plates, wire rods, rails, etc.
[3] Including forged steel castings and other finished products, excluding welded tubes.

Source: Associaziono Nazionale Industrie Siderurgiche (ASSIDER).

The mercury mines, operated by Societá Mercurifera Monte Amiata S.p.A., were closed in July. Low prices for mercury on world markets made mercury mine operations uneconomic.

Pyrite was produced at mines operated by Solmine and situated in Maremma Toscana. The largest mine, Niccoleta, maintained its output level. Development of the Campiano pyrite mine continued during 1976. Three vertical shafts were sunk to a total depth of 900 meters, and an inclined shaft 1,100 meters long was excavated.

NONMETALS

Asbestos.—Societá Amiantifera di Balangero S.p.A., with its San Vittore open pit mine and related facilities located near Turin, remained the principal producer of asbestos in Italy. New equipment for bagging "dust-free" short-fiber filters went onstream at San Vittore. New filters installed at the plant have also lowered air pollution in the area. At the opencast mine, new equipment was installed to enable the mining methods to cope with greater depth and larger quantities of overburden.

Cement.—About 120 cement plants were well distributed over the country and had an installed capacity of 72 million tons. The most important producer of cement was Italcementi S.p.A. with its largest plants at Bergamo, Brescia, and Colleferro. Italcementi accounted for 37% of the country's cement output.

Fluorspar.—Although output was lower when compared with that of 1975, exports were higher because of the sale of fluorspar from stocks. Near the Torgola mine, operated by Societá Fluormina, a new crushing plant went onstream. The plant, with a capacity of 350 tons per day, consists of a primary jaw crusher, a screening installation, and a cone crusher.

Potash.—Industria Sali Potassici e Affini (ISPEA) operated mines at San Cataldo and Palo, which are located in the western part of Caltanissetta Province in Sicily, and from the Racalmuto mine in Agrigento Province. The main processing plant (capacity 240,000 tons of potash salts per year) was situated at Campofranco, about 18 kilometers to the west. The raw material from the mines was treated by a crystallization process patented by Montecatini engineers. Average K_2O content of ore ranged between 10% and 12%.

Salt.—During 1976, the Sicilian Mining Board and Montedison organized a new company, Societá Salitaliana, to coordinate operations of various sources of salt in Sicily. The Montedison 900,000-ton-per-year plant at Cero Marina and all mines operated by the Sicilian Mining Board were incorporated in the new company. Total capacity of the mines involved was about 1.7 million tons.

Stone.—*Marble and Ornamental Stone.*—The output of marble and other ornamental stone was an important segment of the mining industry of the country. The most important of the large producing areas were as follows: Marble at Botticino (Lombardy), Aurisina and Repen (Eastern Venetia), and Trapani (Perlato de Sicilia); granite, at Lago Maggiore (Piedmont) and Sardinia; and travertine, at Tivoli and Rapolano. There were many single locations producing ornamental stone throughout Italy, of which the most important were as follows: Green marble at Val d'Aosta and Val di Susa, rose- and gold-colored marble near Lago Maggiore, black marble at Lago Iseo, red marble at Asiagio, and travertine at Ascoli Piceno. About 3,000 quarries, employing 45,000 to 50,000 persons, were in operation at yearend 1976.

Talc and Graphite.—The Talco Graphite Valchisome Co. produced talc at mines in Piedmont and conducted exploration and preparatory work for opening an opencast mine in Sardinia.

MINERAL FUELS

Petroleum, mostly imported, was the principal source of energy in Italy, supplying 73% of the country's apparent consumption. Domestic energy output (approximately 70% natural gas, 21% hydroelectric power, and the rest petroleum, coal, and fuelwood) accounted for about 15% of the nation's energy apparent consumption. Crude oil imposed a heavy burden on the economy and on the foreign trade balance. Use of nuclear power was being examined as a substitute for oil-fired powerplants.

Coal.—Lignite was produced in two mines, Santa Barbara and Pietrafitta, both near Perugia, operated by Ente Nazionale Electrico (ENEL). All lignite output (2 million tons) was used for fueling ENEL's thermal powerplants. During 1976, the

Table 5.—Italy: Supply and apparent consumption of fuel and power for 1974 and 1975

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood	Hydroelectric and nuclear power	Nuclear power alone
1974:							
Production	28.0	0.7	1.6	20.3	(2)	5.4	0.4
Imports	198.5	12.4	180.1	5.5	(2)	.5	XX
Exports	32.5	.7	31.6	(2)	(2)	.2	XX
Apparent consumption	194.0	12.4	150.1	26.8	(2)	5.7	.4
1975:							
Production	27.0	.5	1.6	19.0	(2)	5.9	.4
Imports	177.8	12.8	153.4	11.0	(2)	.6	XX
Exports	21.3	.7	20.3	--	(2)	.3	XX
Apparent consumption	183.5	12.6	134.7	30.0	(2)	6.2	.4

XX Not applicable.
[1] 1 ton of standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Less than 0.01 million tons of SCE.

Source: World Energy Supplies, 1971–75, Statistical Papers, ser. J, No. 20, United Nations, New York, 1977, p. 231.

heavy rains at the Santa Barbara mine affected production. At Pietrafitta, production has been affected by complicated tectonics and increased depth of lignite seams. Exploratory drilling was underway in marginal areas of the principal basin.

The Carbosulcis Co. was organized to reactivate coal mines in the Sulcis coal basin in Sardinia. Coal in the Sulcis Basin is low in thermal quality and high in sulfur and ash content, but renewed production was needed to decrease Italy's dependence on imported fuels. Imports of coking coal and coke were particularly necessary for operation of metallurgical installations in the country; the United States provided 30% of the 12 million tons of coal imported in 1975.

Petroleum and Natural Gas.—Exploration continued and additional liquid and gaseous hydrocarbons were discovered onshore and offshore. However, future production from the new discoveries will only slightly improve the share of domestic output in the total supply of the country. During 1976, domestic natural gas and petroleum contributed 10% and 0.9%, respectively, to the total energy supply of the country, and imports of crude oil and natural gas heavily taxed the foreign trade balance. During 1976, 36 refineries were in operation with a total installed capacity of over 200 million tons; however, they operated at only 55% of capacity.

In the Po Valley, AGIP Mineraria started production of gas at Malossa, near Bergamo, from a new pay zone 6,200 meters deep. Two other wells encountered difficulties due to high pressure, temperatures, and depth. The new producing zone was discovered by complex geophysical exploration in an old gasfield.

In Prglia, Elf–SNPA–BP announced discovery of a new oilfield offshore in the Adriatic, north of Andria. Reports indicated recoverable reserves of 80 million tons.

Explorazioni Mediterraneo S.A. announced discovery of a new gas pay zone at a depth of 2,670 meters in a well near Castel Volturmo in Casserta Province. The Luna gasfield, located in the general area of Crotone in the Ionian Sea, started production. The field was discovered in 1971, and gas reserves were reported at 18 billion cubic meters.

Uranium and Nuclear Power.—During 1976, Government-owned Azienda General Italiani Petroli S.p.A. (AGIP) started preparations for production of uranium from a deposit near Novazza (Bergamo); recoverable reserves were estimated at 1,500 U_3O_8. In addition, construction started on a yellow cake plant near the mine. Production was scheduled for 1979. For development of the Novazza project, the European Investment Bank granted a loan to AGIP of 9 billion lire (approximately $10 million), repayable in 12 years, with interest at 9.5%.

The Mineral Industry of Japan

By E. Chin [1]

Following the world oil crisis in the autumn of 1973, Japan's economy suffered from inflation, increased unemployment, and excess industrial capacity as a result of decreased demand for its goods and merchandise in domestic and foreign markets. The gross national product (GNP) declined 1.3% in 1974 in real terms, compared with an annual average growth rate of about 8.1% during 1960–73. In 1975, the economy began its upswing and the GNP posted a 2.1% growth in real terms. By 1976, the GNP registered a real growth of 6.3% to $329 billion [2] in 1970 prices. In addition, Japan had a surplus of nearly $3,700 million in its current balance of payments, second only to West Germany among industrial nations.[3]

The Japanese economy had experienced severe inflation in 1974 with consumer prices up 21.8% and wholesale prices up 23.4%; with the fourfold increase in oil prices, there ensued sharp price boosts for manufactured goods, especially for energy-intensive products. In 1975, as a result of restrictive fiscal and monetary policy, the wholesale price increase was a modest 2.1%. In 1976, price increases crept upward but slackened to a rate of 0.1% to 0.3% per month; the overall price level for 1976 averaged 6% higher than in 1975.

The labor market in 1976 showed little improvement over the high unemployment rate of 1975. As the total labor force increased from 53.2 million in 1975 to 53.8 million in 1976, the unemployment rate increased from 1.9% to 2%. While the unemployment rate was considerably lower than that of the United States and European countries, it was contradictory to Japan's tradition of lifetime employment in which employees are seldom dismissed and are retained by firms even during recession periods.

Although the economy was rebounding from a protracted recession, about 25% of the country's industrial production capacity was left idle throughout the year, owing generally to high inventory, curtailment in consumer spending, and decreased export shipments. Industrial activity was reportedly strong in the first half of 1976 and sluggish in the second half. Moreover, production levels varied from industry to industry. The iron and steel, petroleum refining, pulp and paper, electronics (computers), and industrial chemicals sectors managed to sustain production rates approaching the pre-1973 levels. Manufacturers of consumer goods, particularly automobiles and electronic products, benefited from a surge in export demand. Other industries enjoying brisk demand included food processing, rubber, pharmaceuticals, and producers of photographic equipment and supplies. On the other hand, shipbuilding and metalworking, chemical-processing, textile, and bicycle equipment industries generally remained depressed. Other poorly performing sectors included nonferrous metals, nonelectrical machinery, communications equipment, synthetic fibers, and plastics.[4]

The consumption of oil accounted for about 75% of Japan's total use of primary energy, compared with a world average of 45%. Annual domestic production of

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Japanese yen (Y) to U.S. dollars at the rate of Y296.6 = US$1.00.

[3] U.S. Embassy, Tokyo, Japan. Economic Trends Report—Japan. State Department Airgram A–185, Jun. 15, 1977, pp. 2–12.

[4] Japan Economic Journal. Industrial Review of Japan. March 1977, pp. 1–146.

crude oil was equivalent to only 1 day's supply; therefore, the country's requirement for oil was met by purchases from abroad, of which 80% was from the Middle Eastern countries. In 1974 and 1975, the financial stability of oil refineries was weakened by the freezing of oil products prices by the Government, below-cost sales, foreign exchange losses, and an increase in fixed costs for the industry. However, by the end of the third quarter of 1976, oil refiners were posting increased sales and higher pretax profits. The improved performance of the industry was attributed to the establishment of standard prices initiated by the Government in December 1975, gains in foreign exchange resulting from a higher yen (Y) to dollar ratio, and a change in the mix of refinery output, such as increased production of gasoline, a more profitable item.

In 1976, 38 Japanese companies had oil exploration and development operations overseas; 8 of the developers were producing oil and supplied about 8% of the country's total crude imports. Two developers were reportedly close to producing oil, while the remaining 28 operators were expected to begin exploration or test drilling.

At the beginning of the year, Japan's iron and steel industry was buoyed up by sales of sheet to domestic automobile manufacturers and by foreign shipments in general. Because of the bright export market, crude steel output advanced steadily from 25.1 million tons in the first quarter to 28.0 million tons in the third quarter of 1976. Late in the year, however, the industry encountered a slowdown in domestic demand and criticism from abroad urged curtailing exports to the United States and European countries. After regaining momentum, the producers were thus facing operation curtailments again in 1977.

Japan's nonferrous metal industry was troubled by excess inventory, higher cost of production, and fluctuating prices, resulting in production curtailments averaging 20% to 30% throughout the year. For example, 15,000 kilowatt-hours of power was required to produce 1 ton of aluminum ingot. Domestic electricity rates had doubled since the oil crisis, and at Y10 the cost of power per kilowatt-hour was 500% to 1000% higher than the cost of hydropower in the United States and Canada. Owing to the higher cost for power, the Japanese aluminum industry was at a decided disadvantage in international competitiveness.

Production and shipments by lead producers were close to the pre-1973 level as a result of sales in the automotive sector. Because of large inventories, however, producers of copper and zinc operated at about 75% of capacity throughout 1976, and the weak market for sulfuric acid, a byproduct of the copper and zinc industry, was an additional damper to domestic producers. International prices for zinc were relatively stable in 1976. Copper prices fluctuated, and the highest quotation for copper, occurring in midyear, was still below the break-even point for Japanese producers, which was estimated to be around Y600,000 per ton.

The position of the other major mineral sectors, coal and cement, remained depressed in 1976. Total coal output in 1976 was estimated at 18.5 million tons, compared with the current output target of 20 million tons per year and a peak production of 55 million tons in 1961. Japan annually uses about 70 million tons of coking coal for steelmaking and about 10 million tons of steam coal for power generation. Because of the oil embargo of 1973 and the rising prices of crude oil, the Government favored a review of the coal industry and looked to the resurgence of coal as an energy source. Under a proposed coal policy developed in 1976, the Government was to assist collieries in obtaining higher prices for delivery from the user industries inasmuch as domestic coal prices have been semiofficially fixed since 1963 on the basis of recommendations by the Coal Mining Council to the Government. Also, through collaboration between Federal and local governments and the user industries (iron and steel, power, and others), new mines were to be developed to replace superannuated ones.

The construction industry was adversely affected in 1976 by a sharp decline in orders, particularly in private plant equipment investments, and by keen competition, which decreased profits on construction contracts. As a result, the cement industry operated at about 60% of capacity in 1976. In addition, producers were restrained from increasing prices for cement by opposition from the construc-

tion sector. Domestic shipments of cement totaled about 64.5 million tons and exports were 5.9 million tons. Japan's total production capacity remained unchanged from that of 1975 at about 110 million tons.

The Organization for Economic Cooperation and Development (OECD) ranked Japan fourth among the world's plant-exporting nations in 1974 after the United States, West Germany, and the United Kingdom. Because of a rapid growth in plant exports in 1975–76, the OECD rated Japan as the world's third largest exporter, replacing the United Kingdom. To date, the largest export item had been chemical plants, notably to centrally planned economies and to the Middle East. In 1976, total contracts for plant exports were estimated at $9 billion.[5]

At the end of 1976, Japan's cumulative direct foreign investment totaled $17.8 billion. By area, Asia accounted for 27.6% of the total foreign investment, followed by North America, 24.2%; Latin and South America, 17.5%; Europe, 15.3%; Middle East, 6.4%; Oceania, 5.4%; and Africa, 3.6%. By type of industry, manufacturing accounted for 32% of total foreign investment; mining, 26.9%; commerce, 13.7%; and other, 27.4%. Foreign investments for the manufacturing sector included $1.1 billion for chemicals, $1.1 billion for textiles, $0.9 billion for iron and steel and nonferrous metals, $0.6 billion for electrical machinery, $0.6 for lumber pulp, and $1.5 billion for miscellaneous manufactures.

PRODUCTION

Japan was much more important as a consumer of raw materials and as a producer of intermediate and finished products than as an ore producer. In terms of mine output, Japan had minor significance only in the production of clays, dolomite, limestone, and other construction raw materials. Domestic mine output of iron ore, copper, gold and silver, manganese, tin, lead, zinc, salt, and magnesia was supplemented by large imports of these commodities to meet Japan's requirements in the production of value-added goods. Moreover, the aluminum industry was wholly dependent on the imports of bauxite and alumina for metal production.

To meet the country's energy needs, virtually all forms of mineral fuels were imported to sustain Japan's industries. For instance, domestic production of crude oil was only 674,260 kiloliters, compared with imports of 254.2 million kiloliters. Production of liquid petroleum gases (propane, butane, and other) totaled 25,297 tons in 1976; imports of liquefied petroleum gases were 66,774 tons, imports of propane and butane gas were 6,343,257 tons, and imports of liquefied methane gas were 5,791,852 tons. Imports of over 1 million tons of anthracite coal dwarfed domestic production of 38,000 tons in 1976. Bituminous coal production was close to 18.4 million tons and was supplemented by 50.9 million tons imported mainly from the United States, Australia, and Canada.

In terms of mineral and metal processing, however, Japan's industries were very prominent, and output of refined metals and mineral products was large by world standards.[6] Japan ranked within the world's first three producing countries in output of iron and steel, aluminum, copper, and zinc metals, cement, fertilizers, and refined oil. It was also the leading producer, or a major producer, of lesser metals and minerals such as bismuth, cadmium, indium, selenium, silicon, tellurium, titanium, lime, seawater magnesia, talc, and pyrophyllite. In addition, Japan's outputs of coke, lead, industrial gases (argon, nitrogen, and oxygen), and halogens (bromine and iodine) were within the first 10 in world production.

The level of production in mining and manufacturing varied from commodity to commodity. For instance, the total output of the petroleum-refining industry was about 70% of capacity throughout 1976. Coal production dropped from 55 million tons in 1961 to 18.5 million tons in 1976. Output of the iron and steel industry was about 92% of the peak level of production in the period just prior to the 1973 oil crisis. The industry was slowly recovering from the protracted recession, with increased sales to domestic and foreign auto-

[5] Chemical Daily Co., Ltd. Plant Engineering & Technology (PET). July 1977, pp. 1–68.
[6] U.S. Embassy, Tokyo, Japan. 1976 Mineral Production Statistics Questionnaire—Japan. May 20, 1977, pp. 1–14.

Table 1.—Japan: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
METALS				
Aluminum:				
Alumina, gross weight		1,801	1,565	1,411
Metal:				
Primary:				
Regular grade		1,118	1,013	919
High purity		6	3	4
Secondary		517	424	526
Antimony:				
Oxide	tons	4,405	2,851	5,901
Metal	do	2,166	2,523	2,207
Arsenic, white (equivalent of arsenic acid)	do	193	60	60
Bismuth	do	r 833	651	681
Cadmium	do	r 3,027	2,657	e 2,900
Chromium:				
Chromite, gross weight	do	25,858	23,149	22,150
Metal	do	2,146	2,739	2,417
Cobalt metal	do	10	48	515
Columbium and tantalum, tantalum metal	do	r 53	11	42
Copper:				
Mine output, metal content		82	85	82
Metal:				
Blister		953	821	1,002
Refined		996	819	864
Germanium:				
Oxide	tons	16	13	22
Metal	do	17	16	16
Gold:				
Mine output, metal content	thousand troy ounces	140	144	138
Metal	do	1,123	1,044	1,113
Indium metal	do	550	550	600
Iron and steel:				
Iron ore and iron sand concentrate		778	726	758
Roasted pyrite concentrate (50% or more iron)		893	675	653
Pig iron and blast furnace ferroalloys		90,437	86,877	86,576
Electric furnace ferroalloys:				
Ferrochrome		542	486	464
Ferromanganese		624	650	632
Ferronickel		251	201	198
Ferrosilicon		369	327	313
Silicomanganese		448	435	373
Other [1]		21	31	24
Steel:				
Crude		117,131	102,313	107,399
Semimanufactures, hot rolled:				
Ordinary steel		91,039	77,879	83,161
Special steels		9,289	7,955	9,885
Lead:				
Mine output, metal content		44	47	52
Metal, refined:				
Primary		228	194	219
Secondary		49	48	54
Magnesium metal:				
Primary	tons	8,928	8,709	11,190
Secondary	do	10,877	9,227	7,396
Manganese:				
Ore and concentrate, gross weight		167	158	142
Oxide		45	42	33
Metal	tons	8,659	8,270	6,752
Mercury:				
Mine output, metal content	76-pound flasks	551	--	--
Metal	do	r 1,409	--	--
Molybdenum:				
Concentrate output, metal content	tons	106	140	e 140
Metal	do	r 333	206	336
Nickel metal, primary	do	r 20,837	13,019	24,010
Platinum-group metals:				
Palladium metal	troy ounces	13,419	14,751	18,089
Platinum metal	do	5,451	6,065	8,706
Rare-earth metals:				
Lanthanum oxide	tons	130	21	80
Cerium metal	do	289	239	301
Selenium, elemental	do	334	417	460
Silicon metal	do	249	230	283
Silver:				
Mine output, metal content	thousand troy ounces	7,314	8,733	9,299
Metal, primary	do	32,121	31,985	36,522
Tellurium, elemental	tons	26	21	e 29

See footnotes at end of table.

Table 1.—Japan: Production of mineral commodities—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS—Continued			
Tin:			
Mine output, metal content ——tons	548	659	643
Metal:			
Primary ——do	1,328	1,212	1,144
Secondary ——do	102	46	91
Titanium:			
Concentrate ——do	1,398	NA	NA
Slag ——do	4,404	4,483	3,486
Metal ——do	8,913	7,582	6,346
Tungsten:			
Mine output, metal content ——do	r 1,021	969	1,026
Metal ——do	1,655	885	1,431
Uranium metal ——kilograms	r 8,934	3,247	3,043
Zinc:			
Mine output, metal content	r 241	254	260
Oxide	56	52	59
Metal:			
Primary	850	698	742
Secondary	22	63	34
Zirconium metal ——kilograms	15,810	--	--
NONMETALS			
Asbestos	5	5	8
Barite	38	38	54
Bromine, elemental e	11	11	12
Cement, hydraulic	r 73,108	65,517	64,469
Clays:			
Fire clay	1,411	1,178	891
Kaolin	413	206	226
Feldspar [2]	552	363	399
Fertilizer materials:			
Crude potassic (potassium carbonate), gross weight	27	24	e 25
Manufactured:			
Nitrogenous (N content) [3]	2,138	2,341	1,557
Superphosphates	798	520	535
Fluorspar, all grades e	8	8	10
Graphite (crystalline) ——tons	(4)	(4)	--
Gypsum	334	187	65
Iodine, elemental ——tons	6,647	6,813	6,954
Lime (quicklime)	11,215	9,172	9,176
Pyrite and pyrrhotite (including cupreous):			
Gross weight	1,286	1,096	958
Sulfur content	626	539	471
Salt, all types	1,115	1,012	1,021
Sodium and potassium compounds:			
Sodium carbonate	1,327	1,124	1,085
Sodium sulfate	379	294	313
Stone, sand and gravel, n.e.s.: Crushed and broken stone:			
Dolomite	3,390	4,330	5,524
Limestone	160,789	143,857	147,530
Sulfur:			
Elemental [5]	r 2,486	2,285	2,510
Sulfuric acid	7,127	6,000	6,103
Talc and related materials:			
Pyrophyllite	1,396	1,073	1,692
Talc	178	118	105
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	376	370	409
Coal:			
Anthracite	140	92	38
Bituminous [6]	20,193	18,907	18,359
Lignite	75	61	53
Total	20,408	19,060	18,450
Coke, including breeze:			
Metallurgical coke	45,632	44,789	43,446
Metallurgical breeze coke	2,512	2,557	2,181
Gashouse coke including breeze	4,788	4,586	4,131
Fuel briquets, all grades	1,027	633	466
Gas, natural:			
Gross production e [7] ——million cubic feet	102,000	r 99,000	101,000
Marketed ——do	r 101,181	97,815	99,720
Natural gas liquids:			
Natural gasoline ——thousand 42-gallon barrels	41	37	37
Liquefied petroleum gas from natural gas (field plants only) ——do	172	222	293

See footnotes at end of table.

Table 1.—Japan: Production of mineral commodities—Continued

(Thousand metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
MINERAL FUELS AND RELATED MATERIALS—Continued				
Peat e		70	70	70
Petroleum:				
Crude oil	thousand 42-gallon barrels	4,935	4,433	4,241
Refinery products:				
Gasoline:				
Aviation	do	226	229	198
Other	do	168,443	129,766	187,923
Jet fuel	do	20,254	20,950	22,102
Kerosine	do	139,126	129,718	151,567
Distillate fuel oil	do	224,980	215,094	230,939
Residual fuel oil	do	742,364	690,005	674,246
Lubricants	do	15,857	12,810	13,713
Other:				
Asphalt and bitumen	do	28,476	25,746	24,972
Industrial gasoline	do	--	--	1,607
Liquefied petroleum gas	do	51,359	27,612	50,592
Naphtha	do	191,362	165,718	180,897
Paraffin	do	1,150	631	885
Petroleum coke	do	1,154	1,340	1,143
Unfinished oils	do	41,629	36,437	47,489
Refinery fuel and losses	do	74,382	160,035	92,353
Total	do	1,700,762	1,616,091	1,680,626

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Includes (but not limited to) ferromolybdenum, ferrotungsten, ferrovanadium and silicochromium.

[2] Includes aplite as follows in thousand tons: 1974—490; 1975—324; 1976—358.

[3] Nitrogen content of fertilizer for year ended June 30 of that stated.

[4] Revised to none.

[5] Includes byproduct sulfur from sulfide ores and the petroleum industry. Native sulfur is no longer produced.

[6] Includes a small amount of natural coke.

[7] Includes output from gas mines and coal mines.

mobile makers. Lead producers also were supported by the favorable trend in sales of the automotive industry. On the other hand, the aluminum, copper, and zinc industries had large inventories at the end of 1975; coupled with decreased demand, the nonferrous metal sector curtailed production throughout 1976. Production in 1976 by the aluminum industry was about 60% of installed capacity, while that of copper and zinc was between 70% and 80%.

TRADE

Japan's foreign trade in 1976 totaled $132,042 million, compared with $113,608 million in 1975. Total exports increased 21% to $67,210 million in 1976, and imports increased 12% to $64,832 million. The value of imports during the first 5 months of 1976 exceeded that of exports. However, the volume of export shipments increased briskly during the remainder of the year, resulting in a favorable trade balance of $2,378 million for the year. Owing to the oil crisis of 1973 and the ensuing world recession, Japan had had a trade deficit each year during 1973–75.

The United States continued to be the largest market for Japanese products, receiving about 23% of total exports, or $15,690 million. The largest export categories to the United States were transport vehicles, valued at $4,396 million; followed by electrical machinery and equipment, $3,202 million; iron and steel products, $2,558 million; and mechanical machinery and appliances, $1,203 million. Completing the 10 largest export markets for Japan in 1976 were the Republic of Korea, $2,825 million; Liberia, $2,802 million; Australia, $2,306 million; Taiwan, $2,279 million; the U.S.S.R., $2,252 million; West Germany, $2,239 million; Saudi Arabia, $1,888 million; Hong Kong, $1,841 million; and Iran, $1,706 million.

Mineral fuels continued to be the most important import item for Japan, accounting for nearly 44% of the value of total imports in 1976.[7] The value of the imported crude oil alone during the year was $20,131 million, and the oil came principally from Saudi Arabia, $6,306 million; Iran, $4,193 million; and Tunisia, $2,631 million. Imports of steam coal totaled 1.1 million tons, valued at $48.2 million. Major suppliers were Vietnam, the People's Republic of China, Canada, the Republic of South Africa, the Democratic People's Republic of Korea, and the U.S.S.R., in that order.

Imports of metal ores in 1976 included 4.3 million tons of bauxite, 2.6 million tons of copper ore and concentrate, 133.7 million tons of iron ore and concentrate, 0.16 million tons of lead ore and concentrate, 3.5 million tons of nickel ore, and 0.99 million tons of zinc ore. The principal nonmetallic ores and products imported during the year were asbestos, clays, fertilizers, fluorspar, magnesite, stone, sand, and gravel.

By value, the principal sources of Japanese imports during 1976 follow, in million dollars: The United States, 11,818; Saudi Arabia, 7,832; Australia, 5,362; Iran, 4,452; Indonesia, 4,093; Canada, 2,718; the United Arab Emirates, 2,471; Kuwait, 2,017; the Republic of Korea, 1,915; and Taiwan, 1,371.

By industrial classification, Japan was a net importer of animal and vegetable products, oil, foodstuffs, wood and paper products, hides, skins, leather products, footwear and apparel, mineral commodities, gem stones, and precious metals. However, because of the advanced technology and industrial strength of its manufacturing sector, Japan was a net exporter of value-added products such as wrought and unwrought metals, mechanical and electrical machinery, transport vehicles, optical, photographic, and cinematographic equipment, chemicals, plastics, and textiles.

[7] Japan Tariff Association. Japan Exports & Imports—Commodity by Country. December 1976, pp. 1–442, 1–1087.

Table 2.—Japan: Exports of mineral commodities [1]

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal destinations, 1975
METALS				
Aluminum:				
Bauxite and concentrate ---------tons--	146	860	1,066	Republic of Korea 800.
Oxide (alumina) and hydroxide ---------	79	57	123	Republic of Korea 34; Taiwan 7.
Fused alumina ---------tons--	6,054	r 5,290	8,820	Republic of Korea 2,342; Taiwan 1,926.
Metal including alloys, all forms --------	69	136	137	People's Republic of China 39; Republic of Korea 16.
Arsenic trioxide, pentoxide, and acids--tons--	20	6	5	Philippines 3; Indonesia 2.
Beryllium metal including alloys, all forms kilograms--	(2)	91	188	Taiwan 66; Poland 15.
Bismuth metal including alloys, all forms tons--	507	r 362	306	Netherlands 195; United Kingdom 90; United States 71.
Cadmium metal including alloys, all forms do----	1,606	1,471	1,841	Netherlands 764; East Germany 365.
Chromium:				
Chromite ---------do----	244	364	2,089	Republic of Korea 210; Thailand 100.
Oxide and hydroxide ---------do----	r 1,306	749	1,102	Republic of Korea 332; Taiwan 198.
Cobalt oxide and hydroxide ---------do----	12	12	11	Republic of Korea 3; North Korea 2; Taiwan 2.
Columbium and tantalum: Tantalum metal including alloys, all forms -----kilograms--	25,298	8,971	14,934	United States 7,104; West Germany 1,724.
Copper:				
Ore and concentrate ---------tons--	2,299	4,799	--	All to Republic of Korea.
Copper sulfate ---------do----	379	1,523	331	People's Republic of China 760; Peru 350.
Metal including alloys, all forms --------	344	117	163	Hong Kong 17; Taiwan 15; United States 15.
Iron and steel:				
Ore and concentrate ---------tons--	--	--	5	
Scrap ---------do----	301,163	274,759	202,659	Republic of Korea 144,865; United States 47,811.
Pig iron, including cast iron ------do----	72,070	406,846	3 146,331	United States 140,180; Cuba 54,887; Romania 50,127.
Sponge iron, powder, shot --------do----	9,079	7,995	9,739	Republic of South Africa 1,196; Taiwan 1,138.
Spiegeleisen ----------	(4)	--	--	
Ferroalloys:				
Ferromanganese ----------	54	r 131	122	United States 86; West Germany 12.
Other ----------	123	129	89	United States 66; Netherlands 15.
Steel, primary forms ----------	7,595	6,360	5,669	Spain 746; United States 735; People's Republic of China 540.
Semimanufactures:				
Bars, rods, angles, shapes, sections --	r 6,800	r 6,218	9,389	United States 1,121; People's Republic of China 598.
Universals, plates, sheets:				
Universals, plates, sheets, uncoated ----------	9,640	r 8,212	10,976	United States 1,332; People's Republic of China 1,107.
Tinned plates and sheets --------	1,049	865	785	United States 257; U.S.S.R. 81; People's Republic of China 80.
Other coated plates and sheets --	1,562	1,465	2,443	United States 509; Iran 92.
Hoop and strip ----------	734	r 563	967	People's Republic of China 75; Iran 59.
Rails and accessories ----------	114	240	156	Brazil 103; United States 47; Australia 23.

See footnotes at end of table.

Table 2.—Japan: Exports of mineral commodities [1]—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal destinations, 1975
METALS—Continued				
Iron and steel—Continued				
Semimanufactures—Continued				
Wire	511	r 382	419	United States 126; Thailand 21.
Tubes, pipes, fittings	3,856	r 4,541	5,192	United States 927; Iran 445; People's Republic of China 335.
Castings and forgings, rough	13	15	28	United States 8.
Lead:				
Ore and concentrate tons	7,405	--	3,728	
Oxides do	66	266	965	Taiwan 109; Republic of Korea 93; Iraq 50.
Metal including alloys, all forms	35	r 42	12	Netherlands 10; People's Republic of China 9; Republic of Korea 5.
Magnesium metal including alloys, all forms tons	1,461	r 1,549	1,128	United States 1,314.
Manganese:				
Ore and concentrate do	4,887	3,976	6,128	Taiwan 998; Republic of Korea 942; Indonesia 651.
Oxides	36	23	34	United Kingdom 2; United States 1.
Mercury 76-pound flasks	958	1,923	1,223	Algeria 841; Republic of Korea 702; Republic of South Africa 190.
Molybdenum metal including alloys, all forms tons	21	r 16	18	Hungary 7; Romania 3; Republic of Korea 2.
Nickel:				
Ore and concentrate do	--	--	15	
Metal including alloys, all forms do	1,684	3,378	5,523	United States 1,720.
Phosphorus, elemental (red) do	72	182	187	India 75; Iraq 34.
Platinum-group metals and silver:				
Waste and sweepings do	11	1	(5)	All to United States.
Metals including alloys:				
Platinum group thousand troy ounces	230	168	115	Taiwan 129.
Silver do	9,976	8,548	3,691	United States 4,108; United Kingdom 2,218.
Selenium, elemental tons	203	318	352	Netherlands 158; Canada 56.
Tin:				
Oxides do	56	17	29	North Korea 9; Republic of Korea 7.
Metal including alloys, all forms do	r 1,856	r 794	706	Brazil 146; Republic of Korea 124; Cuba 109.
Titanium:				
Oxide	28	r 34	37	United States 22; Republic of Korea 3.
Metal including alloys, all forms tons	3,629	3,274	1,680	United States 1,973; Netherlands 398.
Tungsten metal including alloys, all forms do	114	200	184	United States 64; U.S.S.R. 48; Singapore 17.
Zinc:				
Oxide do	2,492	r 3,688	2,591	Romania 2,030.
Metal including alloys, all forms	r 134	59	82	Iran 7; Taiwan 7; Thailand 5.
Other:				
Ores and concentrates:				
Of titanium, molybdenum, tantalum, zirconium tons	655	4,470	1,346	France 1,535; Taiwan 928; Romania 765.
Of base metals, n.e.s do	35	--	(6)	
Ash and residues containing nonferrous metals do	7,130	3,769	7,188	Belgium-Luxembourg 1,118; Republic of Korea 612; Republic of South Africa 522.
Oxides, hydroxides, and peroxides of metals, n.e.s do	2,220	2,067	1,373	Republic of Korea 975; United States 387.

See footnotes at end of table.

Table 2.—Japan: Exports of mineral commodities [1]—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal destinations, 1975
METALS—Continued				
Other—Continued				
Metals including alloys, all forms:				
Phosphorus and other metalloids tons	502	806	465	Australia 433; India 205.
Alkali, alkaline earth, rare-earth metals do	119	r 186	188	Taiwan 153; Sweden 14.
Pyrophoric alloys do	125	r 80	74	France 37; Nepal 10.
Base metals including alloys, all forms, n.e.s do	7,464	5,027	6,405	United States 1,952; West Germany 1,064.
NONMETALS				
Abrasives, natural, n.e.s.:				
Emery do	931	701	919	Taiwan 362; Republic of Korea 234.
Natural abrasives, n.e.s do	363	160	275	Taiwan 118; Republic of Korea 26.
Dust and powder of precious and semi-precious stones thousand carats	1,387	769	33,339	United States 710.
Grinding and polishing wheels and stones tons	3,111	3,090	4,224	Thailand 426; United States 392.
Asbestos do	180	2,158	3,529	Republic of Korea 888; Taiwan 732; Czechoslovakia 399.
Barite and witherite do	--	95	--	All to Bangladesh.
Boron materials:				
Crude natural borates do	1,207	507	60	Taiwan 420; Republic of Korea 87.
Oxide and acid do	1,155	343	363	Vietnam 190; Taiwan 40; Republic of Korea 33.
Cement	2,302	4,098	5,850	Singapore 768; Indonesia 723; Saudi Arabia 592.
Chalk tons	36	--	50	
Clays and clay products (including all refractory brick):				
Crude clays, n.e.s do	56,733	30,455	37,433	Taiwan 12,585; Republic of Korea 5,354.
Products:				
Refractory do	125,901	r 125,725	118,369	Republic of Korea 33,810; Australia 10,642.
Nonrefractory [7] do	47,814	52,445	44,571	Singapore 12,679; Australia 8,384; United States 7,652.
Cryolite and chiolite do	11	20	10	All to Brazil.
Diamond:				
Gem, not set or strung carats	7,460	3,200	1,664	Hong Kong 3,100.
Industrial thousand carats	11	4	(8)	United States 3.
Diatomite and other infusorial earth tons	981	908	1,151	Taiwan 625; Singapore 70.
Feldspar and fluorspar:				
Feldspar do	7,409	4,495	9,512	Taiwan 3,764; Philippines 438.
Fluorspar, leucite, nepheline, nepheline syenite do	61	343	1,050	North Vietnam 200; South Vietnam 65; Taiwan 36.
Fertilizer materials:				
Manufactured:				
Nitrogenous [9]	3,005	2,734	1,874	People's Republic of China 1,476.
Phosphatic	24	9	18	Taiwan 5; Fiji 2.
Potassic	(8)	6	5	Republic of Korea 3; Thailand 2.
Other, including mixed	74	r 97	80	Thailand 56; North Korea 28.
Ammonia tons	144,738	279,702	284,996	Philippines 200,751.
Graphite, natural do	418	860	1,704	Taiwan 501; Iran 150.
Gypsum and plasters do	2,843	2,584	15,712	Taiwan 1,030; Republic of Korea 746.
Iodine do	6,717	5,116	(10)	United States 2,081; United Kingdom 609.

See footnotes at end of table.

Table 2.—Japan: Exports of mineral commodities [1]—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal destinations, 1975
NONMETALS—Continued				
Kyanite and related materials ---------tons--	20,768	8,592	10,165	Taiwan 5,527; Thailand 1,025; Brazil 1,000.
Lime ----------do----	31,484	31,364	34,312	Malaysia 4,619; Indonesia 4,500.
Magnesite ----------do----	1,134	324	405	Taiwan 302.
Mica ----------do----	257	r 209	349	Republic of Korea 71; Hong Kong 56.
Pigments, mineral, iron oxides, processed do----	12,342	5,746	12,141	Taiwan 2,117; United States 1,238; U.S.S.R. 1,040.
Precious and semiprecious stones, except diamond:				
Natural ----------kilograms--	65,046	84,207	240,899	Republic of Korea 41,141; Taiwan 23,805.
Manufactured ----------do----	22,583	21,521	32,184	Republic of Korea 10,021; West Germany 3,647.
Salt and brines ----------tons--	1,120	1,858	1,059	Republic of Korea 1,255.
Sodium and potassium compounds, n.e.s.:				
Caustic soda ----------	331	365	211	Australia 271.
Caustic potash, sodic and potassic peroxides ----------	4	5	5	United States 3.
Stone, sand and gravel:				
Dimension stone ----------tons--	1,529	330	1,095	Iran 108; North Vietnam 27.
Dolomite, chiefly refractory grade--do----	6,025	7,284	6,909	Philippines 6,896.
Gravel and crushed rock ----------do----	1,199	1,348	9,712	Taiwan 633; Republic of Korea 150; Philippines 123.
Limestone (except dimension) ----------	1,469	1,439	1,488	Australia 1,431.
Quartz and quartzite ----------tons--	1,165	219	133	Philippines 124; Taiwan 67.
Sand, excluding metal bearing ----do----	1,575	1,134	1,899	Taiwan 450; Malaysia 294; Republic of Korea 147.
Sulfur:				
Elemental:				
Other than colloidal ----------do----	62,986	117,267	335,660	Republic of Korea 100,938.
Colloidal ----------do----	114	831	457	Republic of Korea 703; North Vietnam 100.
Sulfur dioxide ----------do----	181	108	55	Australia 88; Taiwan 8.
Sulfuric acid ----------do----	289	r 60	117	Philippines 35; Republic of South Africa 24.
Talc and steatite ----------do----	746	454	1,499	Philippines 94; Taiwan 70; Iran 64.
Other nonmetals, n.e.s.:				
Crude ----------	7	7	10	Taiwan 2; United Arab Emirates 2.
Slag, dross, and similar waste, not metal bearing ----------	39	37	2	Republic of Korea 33.
Oxides, hydroxides, and peroxides of magnesium, strontium and barium (including magnesia clinker) ----------	82	168	125	Netherlands 24; Republic of South Africa 18.
Fluorine and bromine -------kilograms--	8,090	300	[10] 5,517	All to Republic of Korea.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural ---------tons--	11	--	--	
Carbon black and gas carbon:				
Carbon black ----------	14	21	23	Taiwan 4; Thailand 4; Republic of Korea 3.
Gas carbon ----------tons--	3	--	--	
Coal, all grades, including briquets ----------	132	26	51	Republic of Korea 22.
Coke and semicoke ----------	656	733	540	Peru 256; Venezuela 149; Republic of Korea 117.
Gas, manufactured only ----------tons--	([11])	2	16	Indonesia 1; Republic of Korea 1.
Hydrogen and rare gases (helium, neon, krypton, xenon) ----------do----	442	r 426	449	Republic of Korea 98; Saudi Arabia 82; Iran 28.

See footnotes at end of table.

Table 2.—Japan: Exports of mineral commodities [1]—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal destinations, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum:				
Crude and partly refined thousand 42-gallon barrels	16	4	([8])	All to Republic of Korea.
Refinery products, nonbunker:				
Gasoline ---do---	26	r 12	--	Do.
Kerosine and jet fuel ---do---	1,062	66	11	Netherlands 60.
Distillate fuel oil ---do---	495	47	129	Mexico 38.
Residual fuel oil ---do---	12,574	8,415	3	Republic of Korea 2,461; Taiwan 1,703; Sweden 1,415.
Lubricants ---do---	4,496	r 1,826	1,259	Taiwan 572; Republic of Korea 500.
Other:				
Liquefied petroleum gas ---do---	85	92	54	Hong Kong 81.
Naphtha ---do---	1,162	677	([8])	Mainly to Belgium-Luxembourg.
Mineral jelly and wax ---do---	315	237	199	Peru 72; Republic of Korea 45.
Bitumen ---do---	245	136	184	Republic of Korea 58; Nauru 17.
Unspecified ---do---	248	r 87	134	Republic of Korea 48; Taiwan 24.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	51	r 49	95	Republic of Korea 31.

r Revised.
[1] Excludes exports under Japanese-United States Mutual Defense Agreement or for account of U.S. military forces.
[2] Value only reported at $3,894.
[3] Includes spiegeleisen, if any.
[4] Value only reported at $3,922.
[5] Value only reported at $41,460.
[6] Value only reported at $24,141.
[7] Excludes mosaic tile valued as follows: 1974—$88,109; 1975—$43,332; 1976—$71,601.
[8] Less than ½ unit.
[9] Includes exports of the following amounts of urea containing more than 45% nitrogen: 1974—2,249,275 tons; 1975—2,205,265 tons; 1976—746,453 tons.
[10] Iodine is inseparable from fluorine and bromine.
[11] Value only reported at $2,393.

Table 3.—Japan: Imports of mineral commodities [1]

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal sources, 1975
METALS				
Aluminum:				
Bauxite and concentrate	5,311	4,600	4,277	Australia 2,940; Indonesia 985; Malaysia 590.
Oxide and hydroxide	r 14	561	9	Australia 546.
Fused aluminum (artificial corundum)—tons	2,615	598	1,292	United Kingdom 306; United States 176.
Metal including alloys:				
Scrap	25	29	69	United States 19; Canada 4.
Unwrought	479	378	430	New Zealand 83; Canada 48; Bahrain 44.
Semimanufactures	44	22	21	United States 14.
Antimony:				
Ore and concentrate—tons	10,857	9,012	12,703	Bolivia 4,402; People's Republic of China 2,437.
Metal including alloys, all forms—do	589	453	1,055	People's Republic of China 415.
Arsenic:				
Natural sulfides—do	40	20	--	All from People's Republic of China.
Trioxide, pentoxide, and acids—do	1,082	906	1,359	People's Republic of China 457; France 434.
Beryllium metal including alloys, all forms—kilograms	3,139	1,922	3,835	All from United States.
Bismuth metal including alloys, all forms—tons	5	r (2)	--	All from United States and United Kingdom.
Cadmium metal including alloys, all forms—kilograms	9,118	1	--	All from United States.
Chromium:				
Ore and concentrate	1,155	1,269	1,217	India 360; Republic of South Africa 343; Philippines 153.
Oxide and hydroxide—tons	1,645	1,088	2,579	West Germany 459; United States 348; U.S.S.R. 280.
Cobalt:				
Oxide and hydroxide—do	820	252	754	Belgium-Luxembourg 250.
Metal including alloys, all forms—do	3,716	1,581	3,931	Zaire 1,254.
Columbium and tantalum:				
Columbium (niobium) ore and concentrate—do	1,900	2,350	1,813	Nigeria 1,102; Brazil 600.
Tantalum:				
Ore and concentrate—do	109	62	62	Australia 42; Malaysia 10.
Metal including alloys, all forms—do	66	21	50	Mainly from United States.
Copper:				
Ore and concentrate	3,124	2,605	2,587	Canada 868; Philippines 769; Papua New Guinea 271.
Matte, cement copper, native copper	16	--	--	
Copper sulfate [3]—tons	1,629	242	155	People's Republic of China 142; Chile 100.
Metal including alloys:				
Scrap	35	39	34	United States 28.
Unwrought	303	184	233	Zambia 107; Chile 32.
Semimanufactures—tons	16,664	1,729	1,454	United States 783; United Kingdom 277.
Germanium:				
Dioxide—do	17	4	9	U.S.S.R. 2.
Metal including alloys, all forms—kilograms	1,029	5	16	All from Belgium-Luxembourg.
Gold metal—thousand troy ounces	--	--	2,364	
Indium metal including alloys, all forms—kilograms	7,787	4	4,672	All from Netherlands.

See footnotes at end of table.

Table 3.—Japan: Imports of mineral commodities [1]—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal sources, 1975
METALS—Continued				
Iron and steel:				
Ore and concentrate, except roasted pyrite	r 141,816	131,749	133,727	Australia 63,253; Brazil 23,460; India 16,790.
Roasted pyrite ——tons	68	4,173	8,924	Philippines 4,000.
Metal:				
Scrap	r 3,779	3,093	1,802	United States 2,374; Australia 467.
Pig iron, including cast iron	r 1,331	r 399	584	India 101; Republic of Korea 90; West Germany 48.
Sponge iron, powder, shot	22	9	9	Sweden 6.
Ferroalloys	187	90	179	Republic of South Africa 46; Taiwan 15.
Steel, primary forms	133	r 69	223	Australia 53.
Semimanufactures	107	r 41	25	Republic of Korea 23; United States 6.
Lead:				
Ore and concentrate	218	201	155	Canada 137; Peru 38.
Oxides ——tons	r 261	201	410	Bulgaria 119; Mexico 60.
Metal including alloys:				
Scrap ——do	1,677	1,103	1,402	United States 1,042.
Unwrought ——do	36,554	17,202	35,029	Republic of Korea 8,490; Peru 4,138.
Semimanufactures ——do	13	11	10	United States 10.
Magnesium metal including alloys, all forms ——do	13,426	r 4,868	5,109	United States 2,721; U.S.S.R. 1,318.
Manganese:				
Ore and concentrate [4]	r 4,042	3,740	3,356	Republic of South Africa 1,607; India 672; Australia 655.
Oxides ——kilograms	5	24	2,139	West Germany 14; United States 10.
Mercury ——76-pound flasks	7,687	2,567	2,242	Algeria 1,140; Mexico 726; Spain 400.
Molybdenum:				
Ore and concentrate ——tons	17,778	12,128	17,916	United States 6,177; Canada 4,962.
Trioxide ——do	520	90	482	United States 54; Netherlands 35.
Metal including alloys, all forms ——do	147	r 106	39	United States 78.
Nickel:				
Ore and concentrate	4,218	3,397	3,450	New Caledonia 2,492; Indonesia 872.
Matte, speiss, similar materials	40	27	45	Australia 17; Canada 9.
Metal including alloys:				
Scrap ——tons	1,436	1,535	4,737	Taiwan 975; United Kingdom 233.
Unwrought ——do	16,699	8,639	12,150	Canada 2,515; U.S.S.R. 2,168; Republic of South Africa 2,005.
Semimanufactures ——do	4,125	1,656	1,330	United States 896; United Kingdom 449.
Platinum-group metals:				
Waste and sweepings ——value	r $9,413	$46,061	$212,460	Hong Kong $29,579; Taiwan $16,482.
Metals including alloys, all forms:				
Platinum thousand troy ounces	1,194	1,563	1,824	Republic of South Africa 708; U.S.S.R. 478.
Palladium ——troy ounces	678,361	r 441,948	609,473	U.S.S.R. 250,221; Republic of South Africa 95,182; United Kingdom 66,683.
Rhodium ——do	24,574	45,038	28,135	U.S.S.R. 40,938.
Iridium, osmium, ruthenium do	7,715	r 13,079	24,274	United States 7,355; Republic of South Africa 4,249.
Alloys ——do	27,514	29,581	36,342	West Germany 14,969; United States 11,313.

See footnotes at end of table.

Table 3.—Japan: Imports of mineral commodities [1]—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal sources, 1975
METALS—Continued				
Rare-earth metals:				
Oxides and crude chlorides ---tons--	2,157	713	2,688	India 213; Brazil 200; West Germany 165.
Metals (yttrium, scandium, and intermixtures) ------kilograms--	26,141	1,452	2,753	West Germany 1,180.
Selenium, elemental ----------do----	5,493	2,870	1,270	Republic of Korea 1,128; Netherlands 1,000.
Silicon ----------tons--	12,241	3,343	19,069	Norway 924; Canada 676; Sweden 473.
Silver:				
Waste and sweepings ------value--	r $135,374	r $15,633	$3,524	Singapore $13,477.
Ore and concentrate ---------tons--	3,050	3,450	4,250	All from Republic of Korea.
Metal including alloys, all forms thousand troy ounces--	30,989	17,053	20,533	Peru 9,666; Mexico 3,359.
Tellurium ----------kilograms--	4,005	2,518	11,978	U.S.S.R. 2,500.
Tin:				
Ore and concentrate ---------tons--	3	--	92	
Oxide ----------do----	15	13	6	Australia 12.
Metal including alloys, all forms do----	31,240	r 22,052	31,291	Malaysia 9,923; Indonesia 6,036; Thailand 5,425.
Titanium:				
Ore and concentrate ----------	681	444	497	Australia 116; Malaysia 105; India 101.
Slag ----------	r 212	49	33	Canada 47.
Oxide ----------tons--	9,975	2,363	5,750	West Germany 737; France 658; United Kingdom 534.
Tungsten:				
Ore and concentrate ---------do----	3,818	2,027	2,605	Republic of Korea 927; Australia 221; Peru 212.
Metal including alloys, all forms do----	336	22	92	United States 11.
Uranium and thorium:				
Ore and concentrate ---------do----	31	30	100	All from Zaire.
Oxides (compounds of thorium and uranium depleted in U-235) kilograms--	23,839	3,521	6,959	France 3,000; India 350.
Metal including alloys, all forms do----	[5] 4,212	4,440	647	All from United States.
Vanadium pentoxide ----------tons--	3,099	2,876	3,225	Republic of South Africa 2,531; West Germany 300.
Zinc:				
Ore and concentrate ----------	1,216	946	986	Canada 369; Peru 259; Australia 135.
Oxide ----------tons--	3,768	884	1,649	Taiwan 590; Republic of Korea 193.
Metal including alloys, all forms --	25	22	29	North Korea 18.
Zirconium ore and concentrate (including zircon sand) ----------tons--	119,469	85,389	112,925	Australia 83,406.
Other:				
Ores and concentrates of base metals, n.e.s ----------do----	267	114	30	India 90; Bolivia 19.
Ash and residue containing nonferrous metals ----------do----	r 11,057	13,082	21,643	Australia 5,247; North Korea 2,808.
Oxides, hydroxides, and pentoxides of metals, n.e.s.[6] ---------do----	r 1,819	1,977	942	United States 1,340; Canada 637.
Metals including alloys, all forms:				
Metalloids [7] ----------do----	r 16	r 7	6	United States 6.
Alkali and alkaline-earth metals [8] ----------do----	r 7	r 29	63	United States 28.
Pyrophoric alloys (ferrocerium) do----	11	9	14	United Kingdom 3; France 2.
Base metals including alloys, all forms, n.e.s ----------do----	1,171	770	1,099	United States 399; U.S.S.R. 157; United Kingdom 85.

See footnotes at end of table.

Table 3.—Japan: Imports of mineral commodities [1]—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal sources, 1975
NONMETALS				
Abrasives, natural, except diamond, n.e.s.:				
Crude ----------tons--	5,489	1,284	3,120	People's Republic of China 324; India 224.
Dust and powder of precious and semiprecious stones --kilograms--	17,160	8,975	17,340	All from West Germany.
Grinding and polishing wheels and stones ----------tons--	1,200	524	--	Taiwan 144; India 143; Italy 74.
Asbestos ----------	352	253	325	Republic of South Africa 100; U.S.S.R. 72; Canada 69.
Barite and witherite ----------	50	11	17	Mainly from People's Republic of China.
Boron materials:				
Crude natural borates ----------	56	18	36	Turkey 16.
Oxide and acid ----------	19	14	15	United States 11; U.S.S.R. 2.
Cement ----------	77	2	2	Mainly from United States.
Clays and clay products:				
Crude clays, n.e.s.:				
Kaolin ----------	351	284	374	United States 177; Republic of Korea 93.
Kyanite, andalusite, sillimanite	29	24	22	Republic of South Africa 14; India 7.
Other ----------	427	283	256	United States 97; People's Republic of China 71.
Products:				
Refractory (including nonclay bricks) ----------tons--	15,608	9,099	8,323	People's Republic of China 3,913; United States 2,858.
Nonrefractory ----------do----	17,194	r 15,381	24,307	Republic of Korea 7,382; Taiwan 3,408; Italy 3,135.
Cryolite and chiolite ----------do----	1,027	149	257	Denmark 79; Greenland 70.
Diamond:				
Gem, not set or strung thousand carats--	562	648	718	Israel 248; Belgium-Luxembourg 119.
Industrial stones ----------do----	823	421	627	United States 166; Belgium-Luxembourg 87; United Kingdom 79.
Powder and dust ----------do----	8,121	7,485	2,129	United States 4,502; Ireland 1,584.
Diatomite and other infusorial earth tons--	r 4,521	r 4,105	2,656	United States 4,095.
Feldspar, leucite, nepheline, nepheline syenite ----------do----	20,633	5,091	5,346	People's Republic of China 2,125; India 1,436.
Fertilizer materials:				
Crude:				
Nitrogenous (natural sodium nitrate) ----------do----	223	--	--	
Phosphatic ----------	3,845	2,904	2,335	United States 1,753; Morocco 405.
Potassic ----------tons--	781	--	--	
Manufactured:				
Nitrogenous ----------	36	6	18	Chile 5.
Phosphatic ----------	r 118	6	25	Mainly from United States.
Potassic ----------	1,520	r 1,385	1,109	Canada 613; U.S.S.R. 291; United States 153.
Mixed ----------	r 11	78	163	United States 59; Spain 18.
Ammonia ----------tons--	8	8	10	All from United States.
Fluorspar ----------	541	363	383	Thailand 148; People's Republic of China 105.
Graphite, natural ----------	86	58	34	Republic of Korea 28; North Korea 19.
Gypsum and plaster ----------	111	15	35	Mainly from Morocco.

See footnotes at end of table.

Table 3.—Japan: Imports of mineral commodities [1]—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal sources, 1975
NONMETALS—Continued				
Magnesite and magnesia clinker	99	r 80	142	North Korea 53; U.S.S.R. 9.
Mica, all forms	r 100	r 49	9	Switzerland 16; Belgium-Luxembourg 15; India 12.
Pigments, mineral, including processed iron oxides —tons	3,297	2,370	3,170	West Germany 943; People's Republic of China 716.
Precious and semiprecious stones, except diamond:				
Natural —do	1,173	1,144	1,324	Brazil 889.
Manufactured —do	27	49	562	United States 47.
Pyrite (gross weight) —do	65,535	55,887	59,403	All from Philippines.
Salt	7,749	6,302	6,342	Australia 3,209; Mexico 2,703.
Sodium and potassium compounds, n.e.s.:				
Caustic soda —tons	r 17,664	r 2,354	716	United States 2,303.
Caustic potash, sodic and potassic peroxides —do	124	(2)	55	Mainly from West Germany.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	489	259	287	Republic of South Africa 86; Republic of Korea 60; India 38.
Worked	33	19	30	Republic of Korea 11.
Dolomite, including agglomerated dolomite	28	93	199	Mainly from Republic of Korea.
Gravel and crushed rock	153	71	37	Taiwan 55; United States 11.
Limestone —tons	405	249	937	France 244.
Quartz and quartzite	296	166	139	Republic of Korea 124.
Sand, excluding metal bearing	640	428	432	Australia 373.
Sulfur:				
Elemental:				
Other then colloidal —tons	35,761	--	--	
Colloidal —do	446	296	603	United States 290.
Sulfuric acid —do	51,870	14	19	West Germany 13.
Talc, steatite, soapstone, pyrophyllite	299	236	302	People's Republic of China 132; North Korea 44.
Other nonmetals, n.e.s.:				
Crude:				
Meerschaum, amber, jet —kilograms	15	40	153	All from U.S.S.R.
Unspecified	709	228	254	Republic of Korea 123; Australia 26.
Slag, dross, and similar waste, including kelp, not metal bearing	212	r 214	82	United States 82; India 62; Republic of Korea 59.
Oxides, hydroxides, and peroxides of magnesium, strontium, barium —tons	304	122	158	West Germany 77; United States 40.
Bromine and iodine —do	195	7	208	All from Indonesia.
Fluorine —kilograms	26	97	(2)	All from United States.
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural —tons	2,718	2,253	3,228	United States 2,233.
Carbon black	17	4	7	United States 2; U.S.S.R. 1.
Coal and briquets:				
Anthracite	1,517	1,026	1,072	North Vietnam 504; People's Republic of China 333.
Bituminous:				
Heavy coking coal, less than 8% ash	17,623	14,939	22,689	United States 10,122.
Heavy coking coal, more than 8% ash	31,978	33,030	28,211	Australia 15,045; Canada 9,344; United States 6,907.
Other coking coal	13,033	13,112	13,416	Australia 6,738; United States 5,390.

See footnotes at end of table.

Table 3.—Japan: Imports of mineral commodities [1]—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued				
Coal and briquets—Continued				
Lignite and lignite briquets	22	11	12	All from U.S.S.R.
Coke and semicoke	238	191	151	Australia 138; West Germany 38.
Gas, hydrocarbon (liquefied natural gas) thousand 42-gallon barrels	39,373	52,894	67,185	Brunei 40,763; United States 12,131.
Hydrogen, helium, rare gases kilograms	85,568	95,172	104,292	Mainly from United States.
Peat, including briquets and litter_tons	10,043	3,226	7,795	Canada 1,636; Poland 822; U.S.S.R. 399.
Petroleum:				
Crude and partly refined:				
Crude thousand 42-gallon barrels	1,640,078	r 1,600,129	1,598,567	Saudi Arabia 451,082; Iran 418,537; Indonesia 185,031.
Partly refined do	110,959	56,437	NA	Saudi Arabia 43,383.
Refinery products:				
Gasoline do	924	741	6,236	Mainly from Singapore.
Kerosine and jet fuel do	r 3,351	2,434	2,705	Singapore 2,235.
Distillate fuel oil do	r 35,606	r 23,106	35,801	Bahrain 7,765; Singapore 4,652; Kuwait 3,300.
Residual fuel oil do	r 31,036	r 51,876	54,415	Indonesia 16,043.
Lubricants do	r 1,448	r 1,310	875	United States 545; Netherlands Antilles 163.
Other:				
Liquefied petroleum gas do	65,461	r 65,923	74,356	Saudi Arabia 30,538; Australia 13,102.
Naphtha do	r 44,545	r 29,191	45,188	Singapore 9,998; Kuwait 8,424.
Paraffin do	111	80	47	Singapore 63; United States 12.
Petroleum coke do	13,371	r 11,657	10,114	United States 9,970.
Unspecified do	r 320	r 2,738	126	West Germany 308; United States 43.
Total do	196,173	189,056	229,863	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	89	83	116	Republic of Korea 41; United States 26.

r Revised.

[1] Excludes imports under Japanese-United States Mutual Defense Agreement or for account of U.S. military forces.

[2] Less than ½ unit.

[3] Includes zinc sulfate.

[4] Includes ferruginous manganese and manganese dioxide.

[5] Excludes quantity valued at $747.

[6] Includes lithium hydroxide, beryllium oxide, mercury oxide, antimony trioxide, cupreous oxides, hydroxides and peroxides, n.e.s., and silicon dioxides.

[7] Includes phosphorus, boron, and arsenic.

[8] Includes lithium, sodium, alkali metals, n.e.s., and alkaline-earth metals.

COMMODITY REVIEW

METALS

Aluminum.—Total imports of bauxite by Japan were 4.3 million tons in 1976, compared with 4.6 million tons in 1975. Australia continued to be the principal supplier of bauxite for Japan's aluminum industry. In 1976, shipments of bauxite from Australia totaled about 2.7 million tons. About 1 million tons of bauxite was imported from Indonesia, and about 510,000 tons was supplied by Malaysia. The remainder of the bauxite shipments and imports of alumina was from Guyana, China, Trinidad, Surinam, the United States, Greece, and India, in that order.

Imports of unwrought aluminum metal in 1976 totaled 340,435 tons and were principally from New Zealand, Bahrain, Australia, and the United States; imports of unwrought aluminum alloy were 89,700 tons of which about 60% was supplied by the U.S.S.R. Receipts of aluminum waste and scrap during the year totaled 69,304 tons, of which 46,896 tons was from the United States.

Production of alumina by four companies in fiscal 1976 was 1.4 million tons, down 10% from the output in 1975. Alumina production by company was as follows, in tons: Nippon Light Metal Company, Ltd., 520,410; Showa Light Metal Co., 356,074; Sumitomo Aluminium Refining Co., 401,118; and Mitsui Aluminum Co., Ltd., 219,193. The largest decline in output was 22.5% by Showa, followed by Nippon, 9.7%. Production by Sumitomo and Mitsui was up 11.7% and 28.8%, respectively.

Production of primary aluminum metal by 14 smelters of 5 companies was 970,107 tions in fiscal 1976, down 1.8% from that of fiscal 1975. Because of high inventories, the industry operated collectively at about 60% of capacity during the year. Shipments in 1976 totaled 1.2 million tons, up 36.7% from that of 1975. Nippon and Showa were the only companies reporting decreased production from that of 1975. Yearend capacity and production of primary metal in fiscal 1976 by company and plant were as follows, in tons:

Company and plant location	Capacity	Production
Mitsubishi Light Metal:		
Naoetsu	162,000	128,759
Sakaide	195,600	103,840
Mitsui Aluminum: Miike	165,600	102,280
Nippon Light Metal:		
Kambara	95,040	60,809
Niigata	144,960	80,961
Tomakomai	129,960	92,509
Showa Light Metal:		
Chiba	165,720	97,566
Kitakata	28,320	24,852
Omachi	41,340	23,280
Sumitomo Aluminium:		
Kikumoto	79,200	56,787
Nagoya	54,000	42,408
Sakata (Sumikei Aluminium Industry)	14,033	887
Toyama	182,400	126,348
Toyo (Sumitomo Toyo Aluminium Co.)	98,400	28,821
Total	1,556,573	970,107

Production of superpurity aluminum metal was 4,313 tons in 1976, up 59% from the output in 1975. Production was by the Kambara smelter of Nippon (929 tons) and the Kikumoto smelter of Sumitomo (3,384 tons).

By form, the major consumption of aluminum was of rolled products, sashes, castings, wires, and plates. In 1976, Japan's total demand for aluminum manufactures was estimated at 2.1 million tons, up 20% from that of the prior year. By trade classification, consumption was as follows, in thousand tons: Civil engineering and construction applications, 688; transport vehicles, 379; utensils and metal products, 253; communications, 145; electric power and transmission, 84; industrial machinery, 70; miscellaneous uses, 313; and export shipments, 139.

The aluminum industry was a large user of electric power. Because of high costs for production directly related to higher energy costs, producers were able to attain two price increases in 1976, of Y46,000 and Y45,000 per ton, whereby the price per ton of metal climbed from Y280,000 in 1975 to Y371,000 in 1976. Japanese aluminum was not price competitive in international trade, and the producers were faced with lower-priced imports. The industry was hoping that the Government would grant relief measures for power costs. The Ministry of International Trade and Industry (MITI) encouraged the aluminum producers to vertically integrate their operations. By so doing, the profits from production of semimanufacturing operations (rolling, casting, and forging) could be used to cover deficits accrued in smelting.

In 1976, the aluminum divisions of three general chemical companies were reorganized as new companies in an attempt to establish them in a more stable financial position. In April, the aluminum division of Mitsubishi Chemical Industries Limited became Mitsubishi Light Metal Industries, Ltd., an independent company but with support from the Mitsubishi group of enterprises. In July, Sumitomo Aluminium Refining Co., Japan's largest aluminum producer, was capitalized at Y4 billion. In addition to its output capability of 314,000 tons of aluminum metal, 5,000 tons of highpurity metal, and 740,000 tons of alumina, Sumitomo had the sales rights of 100,000 tons of aluminum produced by Sumitomo Toyo Aluminium Co. at Shikoku and 40,000 tons of aluminum produced through its connection with New Zealand Aluminium Smelters Ltd. Effective on October 1, Showa Light Metal Co. was capitalized at Y10 billion (50% by Showa Denko K.K., 35% by the Fuyo Group composed of Fuji Bank, Ltd., and Marubeni Corp., and 15% by consumer interests).

Japan's only new smelter, Sumikei Aluminium Industry, a totally-owned subsidiary of Sumitomo, started operating late in the year. The Y45 billion smelter had an annual output capacity of 45,000 tons of metal. Original plans called for expanding the smelter's capacity to 90,000 tons in 1978, which may be deferred owing to the financial plight of the aluminum industry.

In 1975, the five primary aluminum producers, a group of Japanese trading companies, and the Indonesian Government concluded an agreement for a joint venture involving a hydroelectric power dam and an aluminum smelter at Asahan in North Sumatra. The $870 million project, scheduled for completion in mid-1980, was still in the construction survey stage in 1976.

Nippon Amazon Aluminum Co. (Nalco) and Rio Doce Geologia e Mineração SA, the Brazilian State development and mining firm, agreed to construct an alumina-aluminum facility in Belém at the mouth of the Amazon River. Nalco, composed of 32 Japanese private companies (including the 5 primary aluminum producers), is an investment company for the Albras and Alnorte projects of Rio Doce. Under the Albras project, a $960 million aluminum complex will be constructed with an annual production capacity of 320,000 tons of metal. The Alnorte project involves an outlay of $330 million for constructing an 800,000-ton-per-year alumina plant that will provide the feed for the aluminum smelter.

Copper.—Total mine output of copper ore in 1976 was 82,000 tons (metal content). Production was mainly from Kamaishi, Iwate; Hanaoka, Akita; Kosaka, Akita; Yaguki, Fukushima; and Shimokawa, Hokkaido. During the year, imports of copper ores and concentrates totaled 2.6 million tons and were principally from the Philippines (814,000 tons), Canada (742,000 tons), Papua New Guinea (292,000 tons), Chile (201,000 tons), Australia (154,000 tons), and Indonesia (139,000 tons).

Production of copper blister in 1976 was 1.0 million tons by 11 smelters of 9 companies. Output of refined electrolytic copper totaled 864,000 tons. Japan's copper smelting and refining capacity at yearend 1976 follows, in tons:

Company and plant location	Capacity	
	Smelting	Electrolytic refining
Nippon Mining Co., Ltd.:		
Hitachi	84,000	192,000
Saganoseki	240,000	168,000
Mitsubishi Metal Corporation: Nao-Shima	168,000	168,200
Sumitomo Metal Mining Co., Ltd.:		
Toyo	156,000	48,000
Niihama	--	132,000
Shisaka-Jima [1]	12,000	--
Mitsui Mining & Smelting Co., Ltd.:		
Hibi	68,400	84,000
Takehara	--	84,000
The Dowa Mining Co., Ltd.:		
Kosaka	63,360	45,000
Okayama	--	12,000
Furukawa Mining Co., Ltd.: Ashio	42,000	--
Furukawa Electric Co., Ltd.: Nikko	--	48,000
Rasa Industries, Ltd.: Miyako	31,200	--
Toho Zinc Co., Ltd.: Onahama [2]	--	15,600
Onahama Smelting and Refining Co., Ltd.: Onahama	234,000	234,000
Hibi Kyodo Smelting Co., Ltd.: Tamano	132,000	102,000
Total	1,230,960	1,332,800

[1] Operation discontinued in December 1976.
[2] Operation to be discontinued in March 1977.

Japan's copper industry continued to be plagued with financial difficulties resulting from fluctuating copper prices and increased energy and labor costs. The selling price for electrolytic copper by domestic producers in 1976 was up about 17%. Actual average selling prices by the major producers in 1976 were as follows, in thousand yen per ton (1975 prices in parentheses): Nippon Mining, 443 (381); Mitsubishi Metal, 439 (374); The Dowa Mining, 448 (383); Furukawa, 441 (375); and Toho Zinc, 438 (377). The selling price for copper in 1975 and 1976, however, was well below the average price of Y492,000 per ton in 1974. Toward yearend, the demand for sulfuric acid began to increase as a result of increased domestic and foreign demand for fertilizer. Large stocks of sulfuric acid, a byproduct of smelting, were accumulated in 1975 and copper production was decreased to avoid increasing acid inventory. The consumption of copper in 1976 was estimated at 1.11 million tons and was expected to increase 3% in 1977. Copper for wire and cable constituted 70% of total Japanese consumption, followed by brass and rolled products, 28%, and other uses, 2%.

The Agency of Natural Resources and Energy of MITI estimated that the total copper resources of Japan were 78.9 million tons. Confirmed copper resources totaled 25.2 million tons, grading 1.79% copper; estimated resources were 28.9 million tons, grading 1.68% copper, and prospect resources were 24.8 million tons, grading 1.34% copper.

The Metal Mining Agency of Japan and a consortium of five Japanese copper companies signed a joint venture with Mount Isa Mines Ltd. for a 5-year exploration and feasibility study of the Frieda River area in Papua New Guinea. Copper reserves in the Frieda River area were estimated to be around 400 million tons of 0.47% copper.

The Michiquillay Mining Co., composed of seven Japanese mining companies, submitted a feasibility study on the Michiquillay copper mine to the Government of Peru. The mine, owned previously by ASARCO Incorporated, was nationalized by the Peruvian Government. Surveys of the Michiquillay deposit had confirmed 412 million tons of 0.75% copper ore that could be mined by opencut methods. Plans to develop the copper deposit included an ore-dressing facility with a capacity of 40,000 tons of crude ore per day and a 210-kilometer pipeline for transport of ore slurry from the mine to a port on the Pacific. The cost to develop the mine was estimated at $590 million, excluding the cost of infrastructure which will be borne by the Peruvian Government.

Société de Development Industriel et Minrier du Zaire (SODIMIZA), a joint venture of the Government of Zaire and Japanese concerns, continued the develop-

ment of the copper deposit at Kinsenda. Reserves were estimated at 35 million tons of 5.5% copper. Production was not expected to begin until late 1977.

Iron and Steel.—Japan's steel production of 107.4 million tons in 1976 was 5% higher than in 1975 but well below the peak production of 119.3 million tons in 1973. As the world's third largest steel producer, Japan followed the U.S.S.R. and the United States whose crude steel production was 144.8 million tons and 116.1 million tons, respectively. Japan, however, continued to be the world's foremost exporter of steel with about 36 million tons in 1976, an increase of 25% over shipments in 1975.

Five Japanese steel companies were among the world's top 15 producers in 1976, headed by Nippon Steel Corporation with an output of 34.0 million tons. The other top producers follow, with output in 1976 in million tons: United States Steel Corp., 25.7; British Steel Corp., 19.1; Bethlehem Steel Corp., 17.1; Nippon Kokan K.K., 14.7; Societa Finanziaria Siderurgica (FINSIDER), 13.4; Sumitomo Metal Industries, Ltd., 13.3; Kawasaki Steel Corporation, 13.3; August Thyssen-Hütte A.G., 12.8; National Steel Corp., 9.8; Republic Steel Corp., 8.7; Union Sidérurgique du Nord et de l'Est de la France S.A. (USINOR), 7.9; Kobe Steel, Ltd., 7.8; Broken Hill Pty. Co. Ltd., 7.8; and Inland Steel Co., 7.2.

Japan's industry operated the largest blast furnaces in the world. On September 9, Sumitomo Metal Industries began operation of blast furnace No. 3 at Kashima; with an internal capacity of 5,050 cubic meters, it superseded blast furnace No. 9 (5,026 cubic meters) of the Krivoy Rog Steel Works, U.S.S.R., as the world's largest furnace. Sumitomo began construction of the No. 3 blast furnace in October 1974. Total cost of construction was Y46 billion, which included Y4.6 billion for pollution controls. The furnace had an output capacity of 11,000 tons per day of pig iron.

On October 5, 1976, however, Nippon Steel started operation of its No. 2 blast furnace at the Ōita Works with an internal working volume of 5,070 cubic meters, surpassing Sumitomo's capacity. Construction on this blast furnace, which had an output capacity of 12,000 tons per day of pig iron, began in October 1973. The total cost of this installation was Y300 billion, which also included three units of 340-ton converters, two units of continuous steel casting mills, two units of coking furnaces, a sintering furnace, a heavy plate mill, and an unloader of 2,500-ton-per-hour capacity. With the expanded facilities, the Ōita Works boosted its production capacity for crude steel from 3.6 million tons to 8 million tons per year.

On November 12, 1976, Nippon Kokan K.K. began operation of its No. 1 blast furnace at the Ogishima Works. This blast furnace had an internal capacity of 4,052 cubic meters and a production capacity of 8,000 tons per day of pig iron. Construction on this facility began in December 1974. In addition to the blast furnace, the principal equipment installed included two units of 250-ton converters, a steel mill, a continuous-casting mill, a blooming mill, and a plate mill with an annual output capacity of 1.6 million tons of heavy plate (5.3 meters wide by 25 meters long). Total cost of construction was Y600 billion, which included Y100 billion for land reclamation for the site of the steelworks.

Because Japan relies on foreign sources for the principal raw materials of iron ore and coking coal, the industry strives to lower production costs by using large plants and equipment and advanced operational technology. At yearend 1976, the number of blast furnaces in Japan totaled 72. Thirty-seven had an inner volume of more than 2,000 cubic meters. As of yearend, Japan's 10 largest blast furnaces were as follows:

Company and blast furnace	Inner working volume (cubic meters)	Startup date
Nippon Steel, Oita Works No. 2	5,070	October 1976.
Sumitomo, Kashima Works No. 3	5,050	September 1976.
Nippon Steel, Kimitsu Works No. 4	4,930	October 1975.
Nippon Kokan, Fukuyama Works No. 5	4,617	November 1973.
Kawasaki Steel, Mizushima Works No. 4	4,323	April 1973.
Nippon Kokan, Fukuyama Works No. 4	4,197	April 1971.
Nippon Steel, Oita Works No. 1	4,158	April 1972.
Sumitomo, Kashima Works No. 2	4,080	March 1973.
Nippon Steel, Kimitsu Works No. 3	4,063	September 1971.
Nippon Kokan, Ogishima Works No. 1	4,052	November 1976.

Mine output of iron sands, pyrite sinter, and iron ore constituted about 1% of the total industry requirement. During the year, 133,727,000 tons of iron ore was imported, primarily from Australia (56.1 million tons), Brazil (24.4 million tons), and India (17.2 million tons). Japan's largest iron ore suppliers continued to be Hamersley Iron Pty. Ltd., Mt. Newman Mining Co. Pty. Ltd., Mt. Goldsworthy Mining Associates, Robe River Ltd., and Broken Hill Pty. Co. Ltd. of Australia; Companhía Vale do Río Doce S.A. (CVRD) and Mineração Brasileiras Reunidas S.A. of Brazil; and the Mineral and Metal Trading Corporation of India.

In addition, the industry imported 1.5 million tons of ferruginous manganese ore, 1.8 million tons of manganese ore, 56.5 million tons of coking coal, 0.6 million tons of pig iron, and 1.8 million tons of iron and steel scrap.

About 117.2 million tons of iron sinter and pellet was consumed for ironmaking. In 1976, consumption by the iron and steel producers included 86.7 million tons of pig iron, 38.2 million tons of iron and steel scrap, 44.3 million tons of coke, 63.2 million tons of coking coal, 9.1 kiloliters of heavy fuel oil, 6.2 billion cubic meters of oxygen, 65.2 million kilowatt-hours of electricity, 1.7 million tons of manganese ore, and 18.0 million tons of limestone.

During the year, crude steel production totaled 107.4 million tons. A breakdown of steel production by type of furnace follows, in million tons: Basic oxygen, 86.9; electric, 20.0; and open hearth, 0.5. About 98% of the total output was consumed for rolled products; the remainder was used for forgings and castings. Production of hot-rolled ordinary steel totaled 83.2 million tons, that of hot-rolled special steels was 9.9 million tons, and that of electric furnace ferroalloys was 2.0 million tons.

Steel exports in 1976 were estimated at 36 million tons, valued at $10.9 billion. Compared with 1975 exports, the volume increased 25% and the value increased 4.1%. The average export price per ton in 1976 was $294, compared with $348 in 1975 and $343 in 1974. Exports of ordinary steel products were 32.5 million tons, while shipments of special steel products were 1.7 million tons.

By major destination, 10.9 million tons was shipped to Southeast Asia, the largest market for Japan's steel industry. Exports to China increased 24% to 3.5 million tons in 1976. Shipments to Taiwan and the Republic of Korea were 1.3 million tons and 1.6 million tons, respectively. Demand for steel products in the Middle East was strong, and exports to this area increased 13.9% to 5.2 million tons. Exports to Europe were 8.2 million tons, including 3.0 million tons shipped to the U.S.S.R. Japanese steel exports to the United States totaled 7.4 million tons during the year.

At the request of the European Economic Community (EEC) in 1975, six major steel producers formed a Steel Export Cartel to voluntarily limit shipments to the member countries of EEC in 1976 to 1.22 million tons. Shipments to EEC in 1976 were about 1 million tons; however, sales to EEC neighboring countries sharply increased. The European Coal and Steel Community charged that the inflow of Japanese steel was a damper on the sales of local steel industries in the area. To alleviate the criticism, the Japan Iron & Steel Federation agreed to continue controlling exports in 1977. Later, U.S. steel producers charged that imports of Japanese steel were forcing the U.S. industry to decrease operations and lay off workers. Negotiation continued on establishing reference prices whereby the U.S. industry

would be given a measure of protection from foreign steel.

The financial stability of Japan's small steelmakers, weakened by the prolonged recession, faced further obstacles such as fluctuations in availability of steel scrap, strong competition from major steel companies, weakened position in regard to bargaining power in pricing, and swelling inventories. To overcome these difficulties, Daido Steel Co., Ltd., absorbed Japan Special Steel Co. and Tokushu Seiko Co., Ltd., on September 1, 1976. In addition, Osaka Iron & Steel Co., Ltd., and Ohtani Heavy Industry Co. were expected to merge in June 1977 and begin operations as Godo Steel. The mergers were expected to alleviate some of the difficulties that face the small producers.

Japan's industries are well known for seeking out stable supplies of raw materials throughout the world. Hitherto, raw materials were obtained either as direct purchases or, more recently, through an investment and import policy. A trend, particularly noteworthy in 1976, was an attempt by Japanese industry to directly participate in management and operation of overseas mines. Nippon Steel and Sumitomo Metal Industries approached the owners of the Robe River iron mine in western Australia about obtaining partial management equity. Reportedly, there were similar moves to obtain ownership equity in coking coal mines overseas.

Brazil's State-run CVRD and a consortium of five Japanese companies headed by Kawasaki Steel were expected to form a joint venture for the development and mining of iron ore deposits at Capanema, Minas Gerais State, Brazil. The deposits at Capanema, 300 kilometers north of Rio de Janeiro, were estimated at 233 million tons of hematite and itabirite.

Lead and Zinc.—Japan's lead and zinc industries were interwined, and producers of lead were producers of zinc as well as copper. Domestic mine production supplied about 25% of the total industry smelter output of lead and zinc. The major mines were at Kamioka, Iwate Prefecture; Hanaoka, Akita; Hosokura, Miyagi; Kosaka, Akita; Nakatsu, Fukui; and Toyoha, Hokkaido.

The estimated metal content of domestic lead ore mined in 1976 was 52,000 tons. Imports of lead ore and concentrate totaled 154,601 tons and were principally from Canada, Peru, and the United States, in that order. The remaining 25,955 tons was from Australia, the Philippines, and the Republic of Korea. Receipts of unwrought lead metal were 35,029 tons; shipments from Mexico, North Korea, Peru, and Canada accounted for 96% of the total.

Production of primary lead in 1976 totaled 219,000 tons, compared with 53,800 tons of secondary metal. Total industry shipments of lead in 1976 were 201,631 tons valued at Y32.6 billion, compared with 206,923 tons valued at Y25.3 billion in 1975. The unit value per ton of sales increased Y39,118. The Tokyo price quotation for lead in 1976 began at Y116 per kilogram, increased to Y166 in July, and ended the year at Y157.

Producers of lead by smelter, type of operation, and capacity (as of September 1976) follow, in tons:

Company and plant	Annual capacity	
	Electrolytic	Dry smelting
The Dowa Mining Co., Ltd.: Kosaka	12,000	--
Mitsubishi Cominco: Nao-Shima	--	36,000
Mitsubishi Metal Corporation: Hosokura	19,200	--
Mitsui Mining & Smelting Co., Ltd.:		
Kamioka	30,000	--
Takehara	42,000	--
Nippon Mining Co., Ltd.: Saganoseki	36,000	--
Rasa Industries, Ltd.: Miyako	1,400	--
Sumiko ISP Co., Ltd. (Sumitomo Metal Mining): Harima	26,400	--
Toho Zinc Co., Ltd.: Chigirishima	72,000	--
Total	239,000	36,000

Throughout the year, production of lead (primary and secondary) was close to industry output capacity. Sales of lead were buoyed up by the manufacture of storage batteries and demand for lead by producers of inorganic chemicals. Aside from export shipments, Japan's consumption pattern for lead was as follows: Batteries,

46%; inorganic chemicals, 19%; cable sheathing, 11%; lead pipe and sheet, 8%; and other, 16%.

The estimated metal content of zinc ore mined in 1976 was 260,000 tons. Imports of zinc ore and concentrate during the year totaled 986,053 tons and were mainly from Peru (324,827 tons), Canada (260,647 tons), and Australia (256,085 tons). The remainder was supplied by eight countries. Imports of unalloyed, unwrought metal totaled 27,904 tons, virtually all supplied by North Korea (27,276 tons).

Japan was the world's largest producer of zinc metal. Output in 1976 totaled 742,069 tons of primary metal and was distributed as follows: Electrolytic, 452,560 tons; high purity, 127,728 tons; and distilled, 161,781 tons. Production of secondary metal was 33,976 tons. Total industry output during the year was about 72% of the industry's production capacity. Consumption was estimated at 701,000 tons in 1976: Galvanizing accounted for 386,400 tons; diecasting, 116,900 tons; brass, 99,600 tons; rolled products, 34,700 tons; and other, 63,400 tons. In addition to decreased demand, the industry was plagued with large inventories. Opening and closing stocks for 1976 were 253,500 tons and 251,900 tons, respectively, which were approximately equivalent to a 4-month supply at the current consumption rate.

The price for zinc metal likewise remained depressed throughout the year. The highest price quotation in the Tokyo market was Y243 per kilogram, reached on August 2. The lowest quotation, on December 1, was Y233 per kilogram, equivalent to about $0.3936 per pound.

The prolonged recession that the zinc industry faced in 1974–76 was expected to continue into 1977. Demand for zinc was expected to rise only 4% to 727,000 tons in 1977. Industry stocks were expected to remain at the current levels, and curtailment of output was expected to be 25% to 30%. Moreover, exports of primary metal were expected to be near 60,000 tons in 1977, compared with 80,000 tons in 1976.

Producers of zinc metal by smelter, type of operation, and capacity (as of September 30, 1976) follow, in tons:

Company and plant	Annual capacity	
	Electrolytic refining	Distilling
Akita Zinc Co., Ltd.: Iijima	156,000	--
Hachinohe Smelting Co., Ltd.: Hachinohe	--	84,000
Mitsubishi Metal Corporation:		
Akita	105,600	--
Hosokura	21,600	--
Mitsui Mining & Smelting Co., Ltd.:		
Hiki-Shima	84,000	--
Kamioka	72,000	5,300
Miike	21,600	116,400
Nippon Mining Co., Ltd.: Mikkaichi	--	120,000
Nisso Smelting: Aizu	31,200	--
Ohte Metal (subsidiary of Mitsubishi Metal): Onahama	1,320	--
Sumiko ISP Co., Ltd.: Harima	--	66,000
Toho Zinc Co., Ltd.: Annaka	139,200	--
Total	632,520	391,700

In midyear, MITI formally approved the establishment of the nonprofit Metallic Mineral Stockpiling Association, founded by about 25 metal refiners and manufacturers of copper, lead, and zinc. The Association purchased 13,000 tons of electrolytic copper cathodes and 12,000 tons of electrolytic and distilled zinc. Because of the recovery of the lead market, the Association was expected to use $5 million originally earmarked for lead to purchase additional zinc.

Magnesium.—Production of magnesium metal in 1976 by Furukawa Magnesium Co., Ltd., and Ube Industries, Ltd., totaled 11,190 tons, up 28% from the 1975 output. Total industry production capacity was 12,500 tons (Furukawa, 7,000 tons and Ube, 5,500 tons). Both producers used the Pidgeon process, utilizing domestic dolomite for metal production. Recovery of secondary metal during the year was 7,396 tons. Exports during the year totaled only 1,128 tons, of which the Netherlands, Australia, and the Republic of Korea collectively accounted for 80%. Unit value of exports was $0.92 per pound, equivalent to U.S. quoted prices. Imports of magnesium

were 5,109 tons (unit value about $0.85 per pound) and were all from the world's three largest producing countries, the United States, Norway, and the U.S.S.R.

Total consumption of magnesium metal was estimated at 22,000 tons. In 1976, nearly 8,000 tons of magnesium metal was used as a reductant to produce titanium and zirconium metal. The magnesium chloride generated was reduced back to metal and hence was a nondissipative use. About 10,600 tons of magnesium was used for structural purposes such as castings, aluminum alloys, and mill products. A small portion of magnesium consumed was for dissipative uses in production of nodular iron, powder, and anodes. Unspecified uses in 1976 took about 1,800 tons.

Showa Denko produced small quantities of magnesium metal from its pilot plant at Chichibu, Saitama. Showa Denko had developed a patented vacuum smelting process; the test furnace had an annual capacity of 200 tons of metal.

Manganese.—In 1976, mine production of manganese ore was 141,742 tons, containing about 38,700 tons of manganese. Most of Japan's requirements for manganese, however, were met by imports. Receipts of manganese ore in 1976 were about 3.4 million tons; 44% of the total came from Australia, 25% from the Republic of South Africa, 11% from Gabon, and the remainder from Mexico, Brazil, Malaysia, and a number of other countries. Approximately 97% of the manganese was used in the iron and steel industry. The remainder was consumed in battery manufacture, chemicals, and miscellaneous uses.

Production of electrolytic manganese during the year totaled 6,752 tons, compared with 8,265 tons in 1975. The total output was by two companies, Tekkosha Co., Ltd., and Chuo Denki Kogyo K.K., with a combined annual capacity of 14,000 tons. Production of manganese oxide totaled 33,000 tons and was by Mitsui Mining & Smelting and Daiichi Carbon. Production of ferromanganese and silicomanganese by the iron and steel industry was 632,160 tons and 373,196 tons, respectively.

In 1976, Mitsui Denman (Ireland) Ltd., a joint venture of Mitsui Mining & Smelting (85%), Mitsui & Co., Ltd. (10%), and the Irish Development Authority (5%), began operation of an electrolytic manganese dioxide plant at Little Island in Cork. The plant, which had a 1,000-ton-per-month output capacity of manganese dioxide, used local limestone and sulfuric acid and manganese ore imported from Ghana. As an inducement, the Irish Government granted Mitsui Denman a tax exemption on export profits for a 15-year period. It was believed that the plant would be operating at 90% of capacity by late 1977.

Tekkosha Hellas, a joint venture of Tekkosha Co., Ltd., and Mitsubishi Corporation, began operating an electrolytic manganese dioxide plant in August in the Tessaloniki industrial zone at Tessaloniki, Greece. The plant, with a designed output of about 1,000 tons per month, experienced equipment difficulties, and production was suspended to correct faulty equipment.

Molybdenum.—Domestic mine production of molybdenum ore remained nominal, about 225 tons in 1976. Imports of molybdenum ore during the year totaled 127 tons and were from the United States, West Germany, the Republic of Korea, and Chile, in that order. Receipts of molybdenum concentrates were 17,789 tons principally from the United States (9,187 tons) and Canada (7,168 tons).

The bulk of molybdenum consumption was for the production of ferromolybdenum. During the year, the iron and steel industry produced 4,501 tons of ferromolybdenum. Production of high-purity molybdenum metal totaled 336 tons. Output of fabricated metal products in 1976 included 34 tons of wire, 42 tons of rod, 14 tons of sheet, and 76 tons of other products.

Nickel.—For lack of indigenous resources, Japan imported all of its nickel needs. During 1976, Japan imported 3,450,189 tons of 1.8% to 2.5% nickel ore (2,634,881 tons from New Caledonia, 811,684 tons from Indonesia, and the remainder from the Philippines and the Netherlands) and 45,133 tons of matte and speiss (27,847 tons from Australia, 13,213 tons from Canada, and the remainder from New Caledonia). Receipts of unalloyed nickel metal totaled 11,986 tons and were mainly from the Republic of South Africa (3,013 tons), the U.S.S.R. (2,950 tons), Australia (2,147 tons),

Canada (1,283 tons), the Philippines (1,081 tons), and Norway (1,073 tons). Imports of unalloyed waste and scrap were 60 tons, 60% from the United States. Imports of nickel alloys totaled 277 tons, which included 138 tons from the United States, 99 tons from Egypt, 25 tons from the Republic of South Africa, and 10 tons from the United Kingdom. Receipts of alloy waste and scrap were 4,737 tons and were mainly from the United States, Taiwan, and the United Kingdom. Japan also imported 1,327 tons of semifabricated nickel and alloy products.

Nickel metal production during fiscal 1976 was 24,132 tons and was by Sumitomo Metal Mining (16,665 tons) and Shimura Kako Co., Ltd. (7,467 tons). Consumption of nickel metal in 1976 totaled 27,674 tons and was as follows, by end use: Specialty steels, 8,284 tons; other ferrous alloys, 2,035 tons; nonferrous alloys, 4,895 tons; plating, 7,664 tons; magnets, 98 tons; and miscellaneous, 4,698 tons.

In terms of contained nickel, the quantity of ferronickel consumed was more important than nickel metal consumption. Production of ferronickel in 1976 was 198,000 tons, down 1% from that of 1975. Pacific Metals Co., Ltd., Nippon Yakin Kogyo Co., Ltd., Nippon Mining, Sumitomo Metal Mining, and Shimura Kako were the five companies (with six plants) that produced ferronickel. As in the past, about 97% of the sales of ferronickel was consumed in the production of specialty steels. Most of the remainder was exported.

Shimura Kako reached an agreement with its labor union to transfer its nickel division from Tokyo to Date, Hokkaido. Construction of the nickel refinery at Date was expected to begin in late 1977; the facility was to be constructed adjacent to the company's existing ferronickel plant. The nickel refinery will have an annual production capacity of 10,000 tons of electrolytic nickel and 1,000 tons (nickel content basis) of nickel sulfate. The new plant, which will utilize International Nickel Co. of Canada Ltd.'s (Inco) newly developed electrowinning process, will replace the 7,200-ton-per-year nickel refinery in Tokyo. Total cost of construction was expected to be over Y10 billion.

Indonesia Nickel Development Co. (Indeco), composed of Sumitomo Metal Mining, Nippon Mining, Pacific Metals, Nippon Yakin Kogyo, Mitsui & Co., Mitsubishi Corporation, Sumitomo Shoji Kaisha, Ltd., and Nippon Steel, was expected not to proceed with the nickel development project in Indonesia. The original plans called for the development of the Gebe Island ore deposits and the construction of a 20,000-ton-per-year ferronickel plant near the mine site at a total cost of Y60 billion to Y70 billion. The cost was later revised to Y130 billion, and Indeco indicated that the company may consider developing the mine only for export of ore.

Titanium.—Production of titanium sponge in 1976 by Osaka Titanium Co., Ltd., and Toho Titanium Co., Ltd., totaled 6,346 tons. The companies had a combined rated output capacity of 950 tons per month, indicating that total production during the year was only at 56% of capacity. Titanium metal was used primarily for its corrosion-resistant properties. While consumption of titanium was on the upturn during 1972–74, demand slackened in 1975 and 1976 owing to delayed orders for desalination, petrochemical, and caustic soda plant equipment as a result of the prolonged recession.

Total demand for titanium in 1976, measured in terms of shipments, follows: Domestic consumption, 4,800 tons and exports, 1,680 tons. In comparison, domestic shipments in 1975 were 3,700 tons and exports totaled 3,274 tons. Producers' inventories at the end of 1976 were estimated at 2,000 tons, down slightly from 2,100 tons held at the end of 1975. At the current level of demand, producer stocks were approximately equivalent to a 4-month supply.

Producers negotiated for a 10% price increase for shipments beginning in October. Thirty thousand kilowatt-hours was consumed to produce 1 ton of titanium metal. Moreover, it was estimated that power costs account for 21% of the total cost of production. As electric power charges had been raised 30% and the industry was operating at about 55% of capacity, the producers needed a price increase because of the higher cost of operation per ton of metal produced.

Osaka Titanium was awarded the MITI prize for energy conservation for its

research on integrated reduction and vacuum separation furnace techniques in titanium production. The company built a single-charge 5-ton test furnace and operated the furnace successfully with a 3-ton charge (Japanese reduction furnaces are between 1.5 and 2 tons). The techniques for operating the furnace fully charged were expected to be fully developed by the end of 1977. Test results indicated that the larger charge furnace could result in a 20% reduction (as much as 9,000 to 10,000 kilowatt-hours per charge) in energy consumption for titanium metal production.

In 1976, shipments of titanium ore and concentrate to Japan totaled 496,750 tons. Major suppliers were Australia (203,232 tons), Malaysia (123,825 tons), India (64,006 tons), Sri Lanka (54,568 tons), and Canada (51,063 tons). Only a small portion of the imports was used for metal production. Japan, on the other hand, was a prominent world producer of titanium dioxide (titania), using imported ilmenite as a raw material (some rutile and anatase was also imported). The demand for pigments, the primary market for titanium, was hard-pressed by sluggish domestic and foreign demand, and production of titania was sharply curtailed in 1975. Demand began to recover in 1976, and 346,401 tons of ilmenite was consumed to produce 156,049 tons of titania, compared with 277,573 tons of ilmenite consumed in 1975 for 127,287 tons of titania. Producer-held stocks remained high, at about 1 month's production level. There were six titania producers capable of producing 180,000 tons of titanium dioxide per year. Stocks at yearend 1976 were 15,358 tons, compared with 16,221 tons at yearend 1975. Because of high inventories, two producers, Ishihara Sangyo Kaisha, Ltd., and Sakai Chemical Industry Co., Ltd., were expected to suspend production temporarily in 1977.

Tungsten.—Domestic production of tungsten concentrate in 1976 totaled 1,026 tons and was by Kaneuchi Mining (Kaneuchi and Fujigawa), Nittetsu Mining Co., Ltd. (Yaguki), Awamura Mining (Ōtani), Tanaka Mining (Kuga), Chitose Mining (Takatori), Mitsubishi Metal (Ikuno), and Chugai Mining Co., Ltd. (Tsumo). The largest production was by Kaneuchi Mining (426 tons), followed by Nittetsu Mining (348 tons) and Awamura Mining (221 tons). Imports of tungsten ore totaled 2,605 tons. The largest suppliers were the Republic of Korea (855 tons), Thailand (540 tons), Peru (378 tons), and Australia (313 tons). The remainder of tungsten shipments came from Canada, the United States, China, Portugal, Zaire, Mexico, Bolivia, and Spain, in that order.

Consumption of tungsten was estimated at 3,000 tons. Production of ferrotungsten during the year totaled 447 tons and of tungsten powder, 1,596 tons. Output of fabricated products included fine wire, 66 tons; rod, 89 tons; contacts, 46 tons; copper alloys, 33 tons; silver alloys, 26 tons; thoriated tungsten, 14 tons; and miscellaneous, 67 tons.

Other Metals.—Japan produced only a small quantity of antimony ore. Imports of ore and concentrate totaled 12,703 tons in 1976, of which 66% was supplied by Bolivia. The remainder of the receipts was from 11 countries. Imports of antimony metal totaled 1,055 tons, of which 811 tons was supplied by China, 146 tons by Bolivia, and the remainder by Thailand, the United States, the United Kingdom, Spain, and Yugoslavia, in that order. Output of metal in fiscal 1976 totaled 2,201 tons, of which 1,537 tons was produced by Hibino Metal Industries, 379 tons by Nippon Mining, and 285 tons by Mikuni Refining. Production of antimony oxide in 1976 was 5,901 tons and was by Nippon Mining Sumitomo Metal Mining, Hibino, Mikuni Refining, and Japan Mining, in that order.

Domestic consumption of antimony metal in 1976 was estimated at 2,023 tons distributed as follows, in tons: Batteries, 1,311; hardening alloy for lead, 173; Babbitt metal, 152; type metal, 75; lead pipes and sheets, 28; plating, 12; and other uses, 272. Domestic consumption of metal declined from 3,125 tons in 1973, 2,691 tons in 1974, and 2,117 tons in 1975. Domestic consumption of antimony oxide in 1976 was 4,819 tons, compared with 2,765 tons in 1975 and 3,644 tons in 1974. By far the largest use for the oxide was as a flame retardant, which consumed 3,095 tons in 1976. Other uses included 88 tons for enamel, 50 tons for tartar emetic, and 871 tons for miscellaneous uses.

Production of bismuth metal, a byproduct of lead refining, was 681 tons in 1976.

Domestic consumption of bismuth was estimated at 342 tons, of which the largest use was as a metallurgical additive (120 tons). Ninety-five tons was consumed for condensers, 63 tons for low-fusing alloys, 20 tons for pharmaceuticals, 19 tons for catalysts, and 25 tons for other uses. Exports during the year totaled 306 tons, of which 126 tons was shipped each to the United States and the Netherlands. Contrary to the Japanese consumption pattern, it was estimated that 40% of the world demand for bismuth was for pharmaceutical products manufactured primarily by France.

Japan and the U.S.S.R. were the world's leading producers of cadmium, a byproduct of zinc smelting. Production in 1976 of 2,900 tons was 9% greater than in 1975. The uses for cadmium were in batteries, in pigments, and as a stabilizer for polyvinyl chloride.

Production of cobalt metal, a byproduct of copper and nickel refining, totaled 515 tons in 1976 compared with 48 tons in 1975. Most of Japan's requirements for cobalt were met by imports. During the year, receipts of unwrought cobalt metal totaled 3,148 tons, mainly from Zaire (2,400 tons). Imports of cobalt powder and flake were 686 tons, primarily from Zaire (257 tons) and Belgium (230 tons).

The estimated consumption of cobalt in 1976 was 2,996 tons, compared with 1,979 tons in 1975. Nearly 52% of the total use of cobalt in 1976 was for the production of magnets for small speakers used in radios and television sets. The remainder of cobalt consumption was distributed as follows, in tons: Heat-resistant alloys, 390; high-speed steels, 201; other alloy steels, 238; ultrahard alloys, 122; catalysts, 107; and other uses, 389.

Japan was a major producer of indium, and 1976 output was estimated at 7.7 tons, including recovery from recycled indium products. Toho Zinc was the largest producer with an annual production rate of 3.8 tons. Nippon Mining had an average monthly output of 250 kilograms, with a peak capacity of 280 kilograms. The Dowa Mining began recovering indium in June 1976 from slag generated from gallium processing. The Dowa Mining was capable of producing 50 kilograms per month. Tanaka Electronics Industries, an associated company of Mitsui Mining & Smelting, had a monthly capacity of 50 kilograms of indium. Indium was used in electronics components and solders and other alloys.

Japan was the world's largest producer of selenium. Production in 1976 was 460 tons. Selenium as well as tellurium was recovered as a byproduct in the processing of slimes generated from electrolytic copper refining. The major uses for selenium were in electronics and photocopier components, glass manufacture, chemicals, and pigments. A growing use for selenium was as an addition agent to stainless steel to improve machinability. Selenium addition, in a proportion of 0.15% to 0.16%, improves resistance to corrosion and increases ductility of certain steels.

During 1976, Japan produced 1.11 million troy ounces of gold and 36.5 million troy ounces of silver. Output of gold, derived mainly from the smelting of imported nonferrous ores, was about 7% higher than in 1975. Recovery of silver was at a slightly higher level than in 1973–74 and was about 33% from domestic ores. Domestic production of platinum and palladium was nominal, less than 1,000 kilograms, and Japan had to import these metals in one form or another.

Japan also produced other metals, usually of high purity and generally in quantities prominent by world standards. Output for some of these metals during 1976, mostly from imported materials, follows, in tons: Chromium, 2,417; germanium, 16; germanium oxide, 22; cerium, 301; lanthanum oxide, 80; silicon, 283; tantalum, 42; and uranium, 3.

NONMETALS

Cement.—Japan ranked with the United States and the U.S.S.R. as the foremost producers of cement in the world. Total industry capacity to produce cement was 110 million tons per year. However, total output of cement during the year was only 59% of rated capacity. Production of cement was by 61 plants of 22 companies. By density, Kyūshū District had the highest number of plants, totaling 19; followed by Kantō-Shinetsu, 14; Kinki, 8; Chūgoku, 7; Tohoku, 5; Tokai-Hokuriku, 3; Hokkaido and Shikoku, 2 each; and Okinawa, 1.

Total sales of cement in 1976 (domestic and export shipments) were 64,519,965 tons, up 2.1% over sales in 1975. Domestic

sales of cement by consuming sector in 1976 were estimated as follows: Building construction, 32.7%; civil engineering, 25.4%; concrete products, 15.5%; roads and bridges, 7.3%; harbor construction, 3.0%; railways, 2.8%; electric power, 1.5%; and miscellaneous, 11.8%. Exports of cement during the year totaled almost 5.9 million tons. The major export destinations were Kuwait (1.2 million tons), Singapore (1.1 million tons), the United Arab Emirates and Saudi Arabia (0.7 million tons each), Indonesia (0.6 million tons), Tanzania (0.5 million tons), and Hong Kong (0.3 million tons).

Since 1974, Japan's construction industry had been in a depression which particularly hurt cement producers. Construction orders received by the nation's 43 leading companies in 1976 totaled around Y5.5 billion, down 1.5% from that of a year ago. The 3-year slump in the industry reflected the sharp decline in private plant equipment investments that had played a central role in the construction sector.

Late in 1975, cement manufacturers formed a production cartel to provide temporary relief to the industry in light of slackened demand. In 1976, 20 producers were member companies of The Cement Association of Japan. By banding together, the manufacturers of cement could attempt to lessen competition, make adjustments in production levels, and negotiate higher prices for cement because of increased production costs owing primarily to higher energy costs.

Fertilizer Materials.—Japan's chemical fertilizer industry was one of the largest in the world. In terms of nitrogen fertilizers, Japan ranked fourth in world production after the United States, the U.S.S.R., and China, in that order. The industry's output of calcium and phosphatic fertilizers was large, while that of potassic fertilizers was relatively insignificant.

Japan's production of fertilizer materials during 1976 follows, in thousand tons: Ammonia (100%), 2,621; ammonium sulfate, 2,104; urea, 1,572; ammonium chloride, 703; calcium carbide, 552; calcium superphosphate, 535; calcium cyanamide, 157; and fused magnesium phosphate, 461. Total output of compound fertilizers in 1976 was 3,973,884 tons. There was a decline of about 15.1% in chemical fertilizer production, although the output of compound fertilizers increased 13.7%.

Japan's fertilizer industry has been traditionally export oriented, exporting between 70% and 80% of production. During the year, exports of ammonium sulfate nitrate were 48,861 tons; mixed fertilizers containing nitrogen, phosphorus, and potassium, 23,639 tons; and calcined phosphate, 11,200 tons. By destination, significant quantities of fertilizers were shipped to China, Brazil, India, Taiwan, and the United States.

Japan's industry had been adversely affected by low plant operation rates, international competitiveness, narrowing export markets, and increased costs. Since 1975, there was a marked deterioration in profits, especially for nitrogen fertilizers. Although foreign market prices for ammonium sulfate and urea were increasing, Japanese export prices were still insufficient to cover the added cost of energy and other raw materials. However, the producers agreed with the Federation of Agricultural Cooperative Associations to raise the prices only slightly for urea, lime-nitrogen, and fused phosphorus owing to the increased expenditures for petroleum and electric power. Significantly, the price of naptha, the most widely used feedstock, rose nearly fivefold after the 1973 oil crisis. To worsen the situation, Japanese exports of fertilizers had sharply decreased since 1975.

To remedy the bleak picture, the industry began to reshape its structure, exploit new markets, revamp its distribution system, and retire surplus or outmoded production equipment. The Government was urged to use fertilizers for forests. Also, the Federation advised the industry that surplus ammonia be used more heavily for nonfertilizer applications. In 1976, Mitsubishi Chemical, Nippon Kasei Chemical Co., Ltd., and Sumitomo Chemical Co., Ltd., reduced the capacity of their ammonia plants. Mitsui Toatsu Chemicals, Inc., a leading fertilizer manufacturer, was also expected to reduce its capacity for ammonia and urea.

Magnesium Compounds.—Japan's capacity to produce magnesium oxide from seawater was estimated at 750,000 tons per year. The largest producer was Ube Chemical Industries Co., Ltd., with about 58% of the total output capacity, followed by Shin-Nihon Chemical Industries Co., Hokuriku Seien Kogyo K.K., and Nihon

Kasui Kako Co., in that order. Imports of magnesium carbonate and magnesia clinker during the year were 2,448 tons and 104,549 tons, respectively. By far the largest use for magnesia was in the production of basic refractory heat-insulating bricks for lining metallurgical furnaces, of which the largest consumption was by the iron and steel industry. Exports of basic refractory bricks totaled 35,095 tons in 1976. The remainder of the magnesia consumption, about 10%, was in agricultural and chemical processing applications.

Salt.—Japan's salt production, all from evaporites, was 1,021,000 tons in 1976, compared with imports of 6,341,502 tons. The largest shipments were from Australia, 3,243,837 tons, and Mexico, 2,597,247 tons. The remainder was from China. In 1975 both Australia and Mexico renegotiated price increases for salt exports to Japan. The producers claimed that higher prices were needed to make a reasonable profit. The average unit value of imports in 1976 from Australia was about $15.70 per ton, compared with $12.40 per ton from Mexico.

Aside from human consumption, salt is need in Japan mainly by the chlor-alkali industry. Consumption of industrial salt in 1976 was estimated at about 6 million tons. During the year, Japan produced 2.9 million tons of caustic soda, 1.1 million tons of soda ash, 0.7 million tons of liquid chlorine, 0.7 million tons of 35% grade hydrochloric acid, and 0.2 million tons of 8% bleaching solution.

Throughout 1976, the chlor-alkali industry operated at about 60% of capacity. The industry was faced with depressed demand for caustic soda in 1976 as well as with the Government decree for the industry to switch production technology from mercury cells to a nonmercury technique by March 1978. The financial requirement to change technology was expected to be between Y600 billion and Y800 billion. In addition to declining profits and the prospect of large capital outlay to change technology, the industry faced technical problems. Most producers chose the asbestos diaphragm technique, which resulted in relatively poor product control and increased production costs. However, the producers continued to carry out further research and development efforts.

Asahi Chemical Industry Co., Ltd., adopted an ion exchange membrane technique in a 40,000-ton-per-year plant. Asahi's technique was also incorporated in a 60,000-ton-per-year facility of Denki Kagaku Kogyo K.K., which was completed and started up in 1976. Tokuyama Soda Co., Ltd., was trying out other techniques.

Over industry opposition, the Government approved in May 1976 the application of Dow Chemical Company to allow chlor-alkali production by Dow Chemical Japan, Ltd. Dow's plans called for the construction of a 720,000-ton-per-year caustic soda facility in Japan, which would comprise 16% of the country's total caustic soda capacity.

Sulfur.—The sulfur content of pyrite and pyrrhotite ore processed in 1976 totaled 470,691 tons, compared with 926,180 tons of elemental sulfur recovered from petroleum-refining operations. Domestic consumption of sulfur was estimated at 620,000 tons in 1976. Exports of sulfur during the year were 335,660 tons; the principal destinations were the Republic of Korea (232,117 tons), Taiwan (64,482 tons), and the United States (25,239 tons).

Total industrial production of sulfuric acid was up about 2% to 6,103,427 tons in 1976, compared with total consumption of 6,122,565 tons during the year. Production and yearend capacity of sulfuric acid in 1976 follows, in tons:

Contact process	Production	Capacity
Fertilizer	1,466,226	2,421,775
Smelter	3,348,731	5,422,310
Other	1,288,470	2,417,034
Total	6,103,427	10,261,119

The Sulfuric Acid Association of Japan credited the depressed production and consumption of acid to decreased demand by the fertilizer and synthetic fiber sectors, two of the major consumers of sulfuric acid. Consumption by the fertilizer industry in 1976 totaled 1,883,840 tons, down 6.8% from the 1975 level; that of the textile industry was 888,757 tons, down 1%. The consumption of sulfuric acid by other significant user industries in 1976 follows, in tons: Inorganic chemicals, 1,385,889; mining and smelting, 137,115;

pulp and paper, 128,276; iron and steel, 127,226; organic chemicals, 95,394; and exports, 154,424. The remainder was consumed in a number of applications. The major recipients for the exported sulfuric acid were the Philippines, Turkey, Spain, and Peru, in that order.

MINERAL FUELS

According to the Agency of Natural Resources and Energy of MITI, Japan's total energy supply in 1976 was 3,767,410 billion kilocalories, compared with 3,666,410 billion kilocalories in 1975. Energy supply by source follows, in billion kilocalories: Hydropower, 204,380; nuclear, 90,020; domestic coal, 122,700; imported coal, 462,190; domestic petroleum, 6,320; imported petroleum, 2,534,780; imported petroleum products, 167,400; imported liquefied petroleum gas, 75,890; natural gas, 26,670; and imported liquefied natural gas, 77,060.

Of the total energy supply, imported energy accounted for 88%, with the balance supplied by domestic energy sources, primarily hydropower and coal. Japan's reliance on oil accounted for 71.9% of the total supply in 1976. Following oil, in order of contribution to the energy supply, were coal, 15.5%; hydropower, 5.4%; petroleum and natural gas, 4.8%; and nuclear, 2.4%.

Coal.—Japan's coal mining industry reached its peak in 1961 when output exceeded 55 million tons with about 660 collieries in operation. Subsequently, readily available and low-priced oil rivaled coal as Japan's primary fuel source. After losing ground to oil, the coal industry began closing mines and reducing employment year after year. By 1976, domestic production of coal by 8 companies with 30 collieries and about 20,000 workers was 18.5 million tons, down 3% from the 1975 output. Production during the year was by Mitsui Mining & Smelting; Hokkaido Colliery & Steamship Co., Ltd.; Taiheiyo Coal Mining Co., Ltd.; Mitsubishi Coal Mining Co., Ltd.; Sumitomo Coal Mining Co., Ltd.; Matsushima Coal Mining Co., Ltd.; Joban Coal Mining Co., Ltd.; and Kaijima Coal Mining Co., Ltd.

In 1975, coal output dropped owing principally to gas explosions, flooding, and cave-ins at the Horonai Colliery in Hokkaido, one of the big steam coal mines. Horonai had a yearly output capacity of 1.5 tons of coal, and full production was not expected to be achieved until 1977 when the mine was restored. In addition, Kaijima, one of the small producers, went bankrupt during the year and was preparing to restructure its financial position.

Consumption of coal in steelmaking was much more important than for energy production. In 1976, Japan used 63.2 million tons of coking coal for steelmaking and about 10 million tons of steam coal for power generation. Most of the metallurgical-grade coal imported in 1976 was from Australia (25.0 million tons), the United States (14.9 million tons), Canada (10.3 million tons), and the U.S.S.R. (1.9 million tons). Most of the steam coal was supplied by domestic collieries and supplemented by imports primarily from the United States, Australia, Vietnam, the U.S.S.R., and China.

While the quantity of imports increased about 5% from that of 1975, the value of imports increased about 3%. Japan's coal import bill was $3.6 billion in 1976, compared with $3.5 billion in 1975, $2.9 billion in 1974, and $1.4 billion in 1973.

In 1976, MITI presented a coal policy that sought to assist the sagging coal industry. Included in the recommendations were proposals for the iron and steel industry to deemphasize outright purchases of coal in favor of foreign development and import projects to ensure a stable supply of coal from abroad. The Government was opposed to nationalizing the domestic industry as well as to consolidating the industry into a single corporation. The Government was also to provide assistance by helping the coal producers raise prices for domestic shipments to the power, steel, and other consuming industries. On the recommendation of the Coal Mining Council, Japan's coal prices had been fixed semiofficially since 1963. In 1976, the price of steam coal averaged Y13,130 per ton (up 15% from 1975), while the price of coking coal was fixed in accordance with long term delivery contracts of imported coal. Lastly, the coal industry was urged to develop new mines in collaboration with the Government, regional authorities, and the principal consuming industries.

To decrease dependence on foreign oil supplies, the coal industry was conducting research on coal gasification and liquefac-

tion. For example, Mitsui Mining Co., Ltd., in cooperation with Gulf Oil Corp. was studying coal liquefaction techniques. In addition, a group of Mitsui enterprises began the construction late in 1976 of a pilot plant using an undisclosed technique for the solvent refining of coal. The plant was expected to be completed by the end of 1977 with the capacity to produce 3 tons of low-sulfur-content fuel that was to be used by Nippon Steel and other steelmakers on a trial basis.

Japan Petroleum Development Corporation was expected to lend assistance to 11 Japanese oil, chemical, steel, trading, and banking enterprises for participating in Exxon Corp.'s coal liquefaction project. Exxon was to begin construction of a test plant in Texas in July 1977, capable of producing 600 barrels of synthetic oil per day from 250 tons of coal. The total cost of the project (research, construction, and operation) was estimated at $300 million.

Petroleum and Natural Gas.—Japan's production of crude oil remained minor, amounting to 4.2 million barrels in 1976, compared with imports of 1,599 million barrels valued at about $20.1 billion. Total industry refinery input during the year was 1,680 million barrels, equivalent to 4,603,862 barrels per day. The refinery input of Japan's 10 largest companies follows, in million barrels: Idemitsu Kosan Co., Ltd., 210; Nippon Petroleum Refining Co., Ltd., 160; Toa Nenryo Kogyo K.K., 118; Mitsubishi Sekiyu, 93; Maruzen Sekiyu, 81; Showa Yokkaichi Sekiyu Co., Ltd., 75; Nippon Mining, 68; Koa Sekiyu, 66; Showa Sekiyu, 59; and General Sekiyu Seisei K.K., 55.

As of December 31, 1976, Japan had 49 refineries owned by 31 companies, with a total atmospheric crude distillation capacity of 5,940,360 barrels per stream-day. Corresponding downstream capacities follow, in thousand barrels per day: Vacuum distillation, 1,858; catalytic cracking, 329; catalytic reforming, 605; middle distillates hydrodesulfurization, 1,251; fuel oil desulfurization, 1,351; hydrocracking, 13; lube oil solvent extraction, 72; lube oil solvent deasphalting, 49; lube oil solvent dewaxing, 62; sulfur recovery, 7,754 tons per day; and liquefied petroleum gas recovery, 24,439 tons per day. There were 36 vacuum distillation units, 41 catalytic reforming units, and 19 catalytic cracking units. The refinery input of Japan's 10 largest companies represented 64% of the total industry capacity.

Petroleum refinery output follows, in million barrels: Residual fuel oil, 674; distillate fuel oil, 231; gasoline, 188; kerosine, 152; jet fuel, 22; and lubricants, 14. Other refinery output included 4.4 million tons of asphalt. Japan's capacity by company and plant follows:

Company and refinery	Capacity (barrels per day)	
	December 1975	December 1976
Asia-Kyoseki: Sakaide	150,000	150,000
Asia Sekiyu:		
Hakodate	25,000	25,000
Yokohama	100,000	100,000
Daikyo Sekiyu: Yokkaichi	215,000	215,000
Fuji Kosan K.K.: Kainan	77,600	77,600
Fuji Sekiyu: Sodegaura	210,000	210,000
General Sekiyu Seisei K.K.:		
Kawasaki	55,000	55,000
Sakai	120,000	120,000
Idemitsu Kosan Co., Ltd.:		
Aichi	130,000	130,000
Chiba	310,000	310,000
Hyogo	110,000	110,000
Tokuyama	140,000	140,000
Hokkaido (Tomakomai)	70,000	70,000
Kansai Sekiyu: Sakai	110,000	110,000
Kashima Sekiyu: Kashima	180,000	180,000
Koa Sekiyu:		
Marifu	149,000	149,000
Osaka	80,000	80,000
Kyokuto Sekiyu: Chiba	150,000	150,000
Kyushu Sekiyu: Oita	170,000	170,000
Maruzen Sekiyu:		
Chiba	195,000	195,000
Matsuyama	50,000	50,000
Shimotsu	37,500	37,500
Mitsubishi Sekiyu:		
Kawasaki	105,000	105,000
Mitsushima	270,000	270,000
Nansei Sekiyu: Nishihara (Okinawa)	80,000	80,000
Nichimo Sekiyu Seisei K.K.: Kawasaki	100,000	100,000
Nihon Kokan Kogyo Co., Ltd.:		
Funakawa	14,150	14,150
Mizushima	235,200	235,200
Nihon Sekiyu: Niigata	28,000	26,000
Nihon Sekiyu Seisei:		
Kudamatsu	42,000	42,000
Muroran	110,000	110,000
Negishi	330,000	330,000
Nakagsk (Okinawa)	28,000	28,000
Yokohama	70,000	70,000
Nihonkai Sekiyu: Toyama	60,000	60,000
Okinawa Sekiyu: Henza (Okinawa)	100,000	100,000
Seibu Sekiyu K.K.: Yamaguchi	110,000	190,000
Showa Sekiyu:		
Kawasaki	149,000	149,000
Niigata	43,000	43,000
Showa Yokkaichi Sekiyu Co., Ltd.: Yokkaichi	310,000	310,000
Taiyo Sekiyu: Kikuma	69,000	69,000
Teiseki Topping: Kubiki	4,410	4,410
Toa Nenryo Kogyo K.K.:		
Kawasaki	200,000	200,000
Shimizu	43,500	43,500
Wakayama	187,000	187,000
Toa Oil Co., Ltd.: Kawasaki	100,000	100,000
Toa-Kyoseki: Nagoya	100,000	100,000
Toho Sekiyu: Owase	40,000	40,000
Tohoku Sekiyu: Sendai	100,000	100,000
Total	5,862,360	5,940,360

During the year, 25 wells were completed, comprising 19 exploratory wells and 6 development wells.[8] Japan Petroleum Exploration Co., Ltd., (Japex) conducted onshore drilling in Hokkaido and Niigata, and Teikoku Oil Co., Ltd., drilled on Akita and Niigata. Gulf Oil and Idemitsu completed drilling offshore Okinawa, and Japex Hokkai completed drilling offshore Hokkaido. In addition to the 19 exploratory wells, which were plugged and abandoned, drilling continued at yearend on 7 wells (1 on Okinawa, 5 on Niigata, and 1 offshore Hokkaido). Teikoku Oil suspended drilling at 2,050 meters of the Matsunoyama well in Niigata. Three successful gas wells were reported in 1976: The Yurihara SK–1 and Yurihara SK–2D wells of Japex in Hokkaido and the Kami Tajima 1 well of Teikoku Oil in Niigata.

[8] American Association of Petroleum Geologists Bulletin. Petroleum Development in Far East. V. 61, No. 10, October 1977, pp. 1832–1879.

In September 1976, the development of the Ago-Oki oilfield by Japex Offshore Co., Ltd., was completed and production from the Field was begun. Ago-Oki, discovered in early 1972 by Idemitsu Exploration, Japex, and Amoco International Oil Company, is offshore the city of Niigata in the Sea of Japan. Ultimately the Field will produce 3,000 barrels per day of oil and up to 50 million cubic feet per day of gas. Aside from the Ago-Oki Field, crude oil production was from the Niigata, Yumagata, and Akita Fields in Honshu and the Shiratsukari Field in Hokkaido.

In 1976, eight Japanese oil developers participating in foreign development were producing oil in operations overseas: Arabian Oil Co., Ltd., Zaire Petroleum Co., Ltd., United Petroleum Development Co., Abu Dhabi Oil Co., Ltd., JPDC, C. Itoh Energy Development Co., Ltd., Japex Indonesia Co., Ltd., and Japan Low Sulfur Oil Co., Ltd. Mitsubishi Petroleum Development and Japan Iraq Petroleum Development were preparing to start crude oil production. Eleven companies were due to launch exploration or test drilling in overseas operations. Significantly, the Government-owned JPDC was providing financial aid to 25 of the 40 companies involved with foreign oil development.

In April 1976, Idemitsu was awarded the tender to develop crude oil in the Gulf of Alaska. In partnership with Amoco and Occidental Petroleum, Idemitsu will begin exploratory drilling in 1977. Andes Petroleum Co., Ltd., and Papua New Guinea Petroleum Company withdrew from exploration in Peru and Papua New Guinea, respectively, after conducting unsuccessful test drillings. Kaiyo Oil Co., Toyo Oil Development Co., and Japan Development & Construction Co., Ltd., along with French and other foreign companies that held offshore concessions in Vietnam, were awaiting official approval from the Hanoi Government concerning resumption of operations in Vietnamese waters.

The Mineral Industry of Kenya

By Janice L. W. Jolly [1]

Kenya's mineral industry, excluding refined petroleum products, contributed more than $80 million[2] to the 1976 gross domestic product (GDP) of about $3 billion at current prices. The GDP increased 1% over that of 1975 in constant 1972 prices. Disintegration of the East African Community (EAC) (Kenya, Tanzania, and Uganda) was on the horizon in 1976, prompted by financial disputes, endless bureaucratic muddles, ideological clashes, and other troubles among members. Despite this and a slow economic start at the beginning of 1976, Kenya was expected to realize one of the best economic years in its history in 1977. At yearend 1976, foreign reserves had increased to $273 million. In 1976, coffee was becoming one of Kenya's most valuable export items. Kenya also enjoyed good receipts during the year from exported refined petroleum products and cement. Petroleum and allied products accounted for 25% of Kenya's $945.1 million import bill. A 12.5% devaluation of the Kenyan shilling in October 1975, plus a sizable increase in taxes on luxury goods, helped reduce imports in 1976.

Active U.S. commercial involvement in Kenya was evidenced by the Overseas Private Investment Corp.'s (OPIC) efforts through loans, investment insurance, and OPIC's own equity participation. The Eximbank also offered financing for development projects. Teams from both Eximbank and OPIC visited Kenya in 1976 and gave a favorable report on the business climate. Kenya's State-owned Industrial and Commercial Development Corp. (ICDC) was actively looking for foreign investment partners. The World Bank and its affiliate, the International Development Association (IDA), were to give Kenya loans and credits totaling $45 million. Kenya also received $3.6 million from the African Development Bank and $2.3 million from the European Investment Bank to finance industrial development.[3] The United Kingdom and West Germany had negotiated development loan schemes with the Kenyan Government for a wide range of projects.

In an effort to promote West German investment in the country, Kenya and West Germany signed an agreement for relief of double taxation. The agreement will apply to taxes on income and capital imposed on behalf of each of the contracting States, their political subdivisions, or local authorities, regardless of the manner in which the taxes are levied. It will apply to all classes of income including capital gains, royalties, pensions, and annuities. An accord for bilateral cooperation was signed by Kenya and the Republic of Korea.

Kenya and Sudan have contracted the Norwegian Agency for International Development (Norad) to make a feasibility study for the new road to be built between Lodwar in northwestern Kenya and Juba in Sudan, a distance of about 500 kilometers. The road project was expected to cost about $1.2 million, and will help in the development of the isolated and semi-desert area of northern Kenya. Juba is the capital of Sudan's southernmost province and is one of Africa's most inaccessible areas, having no outside rail or paved road

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Kenyan shillings (K Sh) to U.S. dollars at the rate of K Sh8.26 = US$1.00.

[3] Africa Report, Kenya. January–February 1977, p. 35.

links. The road will provide an alternative to the present route from Sudan which transits Uganda to Kenya, as well as facilitating exports of cement, fuels, and chemicals (chiefly soda ash) to Sudan.

The Tana River Development Co. Ltd. signed a $44 million contract for the main civil works of the Gitaru hydroelectric project which, when completed in 1978, will have cost an estimated $363 million. Gitaru will generate 144 megawatts, almost 75% of the country's energy requirements of 200 megawatts. Contractors for the project were Skanska Cementgjuteriet AB of Sweden and Stirling Astaldi Ltd. of the United Kingdom. The project was being jointly financed by the World Bank, the Commonwealth Development Corp., the Kenyan Government, and the East African Power and Lighting Co. (EAPLC), under the overall supervision of Tana River.

Exploration continued on the geothermal energy potential of the Olkaria zone in the Rift Valley Province. With financial aid from the United Nations, French and Swiss companies were contracted to conduct studies for the EAPLC.

The fourth session of the United Nations Conference on Trade and Development (UNCTAD) was held in Nairobi on May 3–28, 1976. The program dealt with, among other things, commodities, manufactures, and semimanufactures; multilateral trade negotiations; money and finance for resource development; transfer of technology; and economic cooperation between developing countries and their trade relations.

Mineral exploration activity continued to increase in 1976. Field and laboratory capabilities of the Kenyan Mines and Geological Department were strengthened through the provision of technical experts and exploration equipment by the Canadian International Development Agency (CIDA). Field reconnaissance was being carried out in two major geological provinces—the Archaean volcanic sequences of Rift Valley Province and the Permian-Triassic sediments of the Coast Province. The Archaean volcanics were thought to be good hosts for massive base metal deposits. CIDA was to carry out airborne geophysical surveys in selected areas beginning in 1977. Zinc sulfide and uranium mineralization was being sought in the Coast Province, and an airborne magnetic-radiometric survey was to be carried out over selected Karroo sandstone areas. The survey was expected to be eventually extended west, using magnetometer only, toward the basement rocks being mapped by the Mines and Geological Department/Austromineral Project. Renewed interest was also being shown in the mineral potential of a large carbonatite-syenite complex intruding into the Permian-Triassic sediments near the coast. The complex was being examined to determine its niobium, phosphate, and base metal potential.

PRODUCTION AND TRADE

Mineral production in 1976 consisted of petroleum products produced from imported crude oil; limestone, limestone products, clinker, and cement (valued at $64 million); soda ash and salt (valued at $10.4 million); fluorspar (valued at $4.9 million); and many less significant mineral products produced mostly for local use, including calcite, diatomite, carbon dioxide gas, feldspar, gold, guano, magnetite, magnesite, lead ore, gem stones, vermiculite, and clays.

Cement production of 982,800 tons was up 10% from 1975 production, and advance orders signaled a promising year for 1977. The world market for soda ash was affected by continued slackened demand, but Kenya's soda ash production was up about 26% from that of 1975. The 1976 production rate for soda ash was only 58% of potential output.

Net imports of petroleum and petroleum products totaled $82 million in 1976. Exports of refined petroleum products, Kenya's second most important foreign-exchange earner after coffee, increased in value but declined in volume. Crude oil throughput at the refinery was reported as 19.1 million barrels, a 9% decrease from that of 1975. Crude oil supplies came from Iran and Saudi Arabia.

Total exports, excluding EAC trade, increased 29% to $668.4 million in 1976; these went mainly to West Germany, the

United Kingdom, the United States, the Netherlands, Zambia, and Japan. Trade with West Germany, the United States, and the Netherlands increased more than 100% in 1976.[4] Exports to Tanzania increased 13.3% and to Uganda, 4%. The value of total intracommunity trade in the EAC increased 12% in 1976 to $159.7 million.

The United States was becoming one of Kenya's most important economic partners. Trade with the United States increased about 25% owing to a doubling of exports. U.S. exports to Kenya were expected to increase 12% in 1977. In 1976, high coffee prices narrowed the trade deficit with the United States to $13 million from $40 million in 1975.

[4] U.S. Embassy, Nairobi, Kenya. Department of Commerce. Foreign Economic Trends and their Implications for the United States. No. 77-121, August 1977, 11 pp.

Table 1.—Kenya: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Copper, mine output, metal content e	70	70	70
Gold, mine output, metal content—troy ounces	r 214	108	33
Iron and steel: Iron ore, gross weight	19,780	16,800	e 17,000
Lead, mine output, metal content e	r 480	r 1,100	480
Silver, mine output, metal content—troy ounces	r 19,818	r e 42,800	e 19,300
NONMETALS			
Barite	442	376	e 400
Cement, hydraulic	r 856,466	897,077	982,800
Clays, kaolin	(1)	(1)	--
Diatomite	1,657	1,799	2,668
Feldspar	2,842	1,616	e 1,600
Fertilizer materials, crude, phosphatic, guano	352	297	219
Fluorspar	38,500	54,600	75,027
Gem stones, precious and semiprecious:			
Garnet [2]—kilograms	6	NA	NA
Ruby—do	23	NA	NA
Sapphire—do	295	NA	NA
Tourmaline—do	9	NA	NA
Gypsum and anhydrite	e 100,000	e 100,000	78,020
Lime	e 32,000	197,414	31,739
Magnesite, crude e	10	10	10
Salt:			
Crude e	35,000	35,000	50,000
Refined	r 19,826	21,012	14,250
Soda ash	r 155,997	91,733	115,214
Soda, raw crushed (trona)	1,546	2,310	2,933
Stone, sand and gravel:			
Calcareous:			
Calcite	300	150	NA
Coral (for cement manufacture)	947,370	NA	NA
Kunkur (for cement manufacture)	NA	133,830	176,798
Limestone (for cement manufacture)	NA	181,038	193,157
Sand	17,209	NA	NA
Shale	167,240	NA	NA
Vermiculite	1,683	7,483	3,587
Wollastonite	100	60	NA
MINERAL FUELS AND RELATED MATERIALS			
Carbon dioxide, natural	2,187	NA	2,147
Petroleum refinery products:			
Gasoline, motor—thousand 42-gallon barrels	3,034	2,988	3,091
Jet fuel—do	2,422	3,397	3,046
Kerosine—do	561	366	338
Distillate fuel oil—do	7,224	6,979	3,654
Residual fuel oil—do	6,860	6,067	7,504
Lubricants—do	--	35	--
Other:			
Asphalt—do	222	247	--
Liquefied petroleum gas—do	201	206	213
Unspecified—do	--	--	268
Refinery fuel and losses—do	760	761	974
Total—do	21,274	21,046	19,088

e Estimate. p Preliminary. r Revised. NA Not available.
[1] Revised to none.
[2] Quality (gem or industrial) not specified.

Table 2.—Kenya: Exports and reexports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS			
Aluminum metal including alloys:			
Scrap		645	431
Unwrought and semimanufactures	value	$353,409	$206,618
Copper metal including alloys:			
Scrap		1,359	759
Unwrought and semimanufactures	value	$30,339	$22,665
Iron and steel metal:			
Scrap		5,054	4,677
Semimanufactures:			
Bars, rods, angles, shapes, sections		3,016	1,682
Universals, plates, sheets		7,672	1,189
Hoop and strip		54	157
Wire		707	174
Tubes, pipes, fittings		1,284	935
Castings and forgings, rough		(2)	11
Lead:			
Ore and concentrate		797	1,774
Metal including alloys:			
Scrap		689	2,431
Unwrought and semimanufactures		5	(2)
Magnesium metal including alloys, scrap		7	8
Tin metal including alloys, scrap		--	55
Zinc metal including alloys:			
Scrap		837	341
Unwrought and semimanufactures		50	--
Other: Ash and residue containing nonferrous metals, n.e.s		79	5
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		597	632
Dust and powder of precious and semiprecious stones		1	--
Grinding and polishing wheels and stones	value	r $944	$351
Barite and witherite	do	$4,581	$526
Cement		530,130	550,419
Chalk	value	$8,429	$79,955
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s		13	72
Products		302	459
Diatomite and other infusorial earth		--	81
Feldspar and fluorspar		37,763	49,684
Fertilizer materials, manufactured:			
Nitrogenous		210	3 1
Phosphatic		110	--
Other, including mixed		2	--
Graphite, natural		1	73
Gypsum and plasters		3,040	3,093
Lime		1,416	2,907
Precious and semiprecious stones, except diamond, natural	value, thousands	$881	$1,302
Salt and brine		924	555
Sodium compounds:			
Caustic soda		476	209
Sodium carbonate, soda ash		139,869	86,769
Stone, sand and gravel:			
Dimension stone, crude and partly worked		7	42
Dolomite		--	5
Gravel and crushed rock		66	1,018
Limestone (except dimension)		63	--
Sand, excluding metal bearing		101	15
Sulfur:			
Elemental		26	--
Sulfuric acid, oleum		11	16
Other nonmetals, n.e.s.:			
Crude	value	$498,737	$392,041
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals		r 12	272
MINERAL FUELS AND RELATED MATERIALS			
Coal, anthracite and bituminous		18	--
Petroleum:			
Crude	thousand 42-gallon barrels	4	--
Refinery products: [4]			
Gasoline	do	1,304	1,297
Kerosine	do	r 524	550
Jet fuel	do	1,292	1,369
Distillate fuel oil	do	1,915	1,769

See footnotes at end of table.

Table 2.—Kenya: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
MINERAL FUELS AND RELATED MATERIALS—Continued		
Petroleum—Continued		
Refinery products [4]—Continued		
Residual fuel oil ---thousand 42-gallon barrels--	6,397	4,648
Lubricants ---do---	448	422
Other:		
Liquefied petroleum gas ---do---	36	56
Nonlubricating oils, n.e.s ---do---	4	2
Bitumen and other residues and bituminous mixtures, n.e.s-do---	101	92
Unspecified ---do---	1	1
Total ---do---	r 12,022	10,206
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ----	138	381

r Revised.
[1] Includes transfers to Uganda and Tanzania.
[2] Less than ½ unit.
[3] Excludes quantity valued at $292.
[4] Includes bunkers.

Table 3.—Kenya: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys:		
Scrap	5	2
Unwrought	1	2
Semimanufactures	2,764	2,016
Copper metal including alloys:		
Scrap	39	11
Unwrought	26	5
Semimanufactures	1,038	843
Gold:		
Metal ---troy ounces--	11,094	4,985
Waste and sweepings ---do---	--	29
Iron and steel:		
Ore and concentrate	2	--
Metal:		
Scrap	620	84
Pig iron, ferroalloys, similar materials	362	1,081
Steel, primary forms	19,569	13,496
Semimanufactures:		
Bars, rods, angles, shapes, sections	24,298	12,047
Universals, plates, sheets	127,748	49,775
Hoop and strip	2,780	1,418
Rails and accessories	6,578	3,744
Wire	23,244	8,603
Tubes, pipes, fittings	12,045	9,447
Castings and forgings, rough ---value--	$13,172	--
Lead metal including alloys:		
Scrap	2	--
Unwrought	2,209	329
Semimanufactures	130	115
Magnesium metal including alloys, semimanufactures	1	1
Manganese ore and concentrate	715	639
Molybdenum metal including alloys, all forms	--	4
Nickel:		
Ore and concentrate	10	--
Metal including alloys, unwrought and semimanufactures ---value--	$20,063	$28,745
Platinum-group metals including alloys, all forms, but not rolled-troy ounces--	163	39
Silver metal including alloys ---do---	20,475	16,250
Tin metal including alloys:		
Scrap	406	365
Unwrought	51	21
Semimanufactures	340	[2] 856
Tungsten metal including alloys, all forms	3	--

See footnotes at end of table.

Table 3.—Kenya: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS—Continued			
Zinc metal including alloys:			
Scrap and blue powder		16	2
Unwrought		5,080	876
Semimanufactures		715	665
Other:			
Ores and concentrates of base metals, n.e.s		82	20
Ash and residue containing nonferrous metals		16	--
Metals including alloys, n.e.s.:			
Pyrophoric alloys	value	$15,473	$7,168
Base metals		10	31
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		61	6
Dust and powder of precious and semiprecious stones		97	1
Grinding and polishing wheels and stones		r 98	48
Asbestos		305	743
Barite and witherite	value	$2,305	--
Cement		638	330
Chalk	value	$2,995	$18,841
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s		1,078	706
Products:			
Refractory (including nonclay bricks)		1,298	3,583
Nonrefractory		1,544	1,250
Diamond, gem, not set or strung	carats	370	25
Diatomite and other infusorial earth		133	267
Fertilizer materials:			
Crude:			
Phosphatic		224	17
Potassic		426	--
Manufactured:			
Nitrogenous		104,268	44,379
Phosphatic		r 49,540	30,626
Potassic		3,531	682
Other, including mixed		34,961	33,146
Ammonia		94	152
Graphite, natural		1	11
Gypsum and plasters		3,522	123
Lime		90	1
Magnesite		5	8
Mica:			
Crude, including splittings and waste		18	21
Worked, including agglomerated splittings	value	$6,335	$6,891
Pigments, mineral, natural, crude	do	$122,472	$23,677
Precious and semiprecious stones, except diamond:			
Natural	do	$14,792	$17,551
Manufactured	do	$24,365	$13,607
Salt and brine		28,863	1,262
Sodium and potassium compounds, n.e.s.:			
Caustic soda		6,024	3,470
Sodium carbonate (soda ash)		7	5
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked		25	194
Worked		76	25
Dolomite, chiefly refractory grade		551	303
Gravel and crushed rock, n.e.s		88	102
Quartz and quartzite		21	1
Sand, excluding metal bearing		836	457
Sulfur:			
Elemental		1,774	614
Sulfuric acid, oleum		1,350	1,213
Talc, steatite, soapstone, pyrophyllite	value	$102,689	$239,637
Other nonmetals, n.e.s.:			
Crude	do	$9,289	$99,119
Slag, dross, similar waste, not metal bearing		210	210
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		93	159
Coal and briquets:			
Anthracite and bituminous		66,125	43,914
Lignite and lignite briquets		--	1
Coke and semicoke		535	1,905
Peat, including peat briquets and litter		2	1

See footnotes at end of table.

Table 3.—Kenya: Imports of mineral commodities [1]—Continued
(Metric tons unless otherwise specified)

Commodity		1974	1975
MINERAL FUELS AND RELATED MATERIALS—Continued			
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	20,667	20,788
Refinery products:			
Gasoline	do	408	106
Kerosine and jet fuel	do	665	58
Distillate fuel oil	do	528	[3]
Lubricants	do	r 706	545
Mineral jelly and wax	do	18	9
Other:			
Nonlubricating oils, n.e.s	do	16	3
Unspecified	do	10	21
Mineral tar and other coal–, petroleum–, or gas–derived crude chemicals		2,822	2,453

r Revised.
[1] Includes transfers from Uganda and Tanzania.
[2] Excludes quantity valued at $1,477.
[3] Less than ½ unit.

COMMODITY REVIEW

METALS

Chromite.—The Japanese consortium investigating the chromite and garnierite deposits of Telot in the West Pokot District of the Rift Valley Province was withdrawing from exploration. The Kenya Geological Survey had estimated about 60,000 tons of chromite at Telot based on projected connection of drillholes. The Japanese did additional drilling and concluded that the deposit consisted of several small pods rather than a large continuous one as formerly projected. Based on their exploration, the Japanese put the reserve estimate nearer to 8,000 tons. However, Kenyan authorities suspected that the Japanese had only investigated the central portion of a much larger known occurrence of these podiform bodies. There is another area of chromite occurring on the eastern range of the Great Rift Valley, which had not been investigated sufficiently to estimate reserves. For a summary of known chromite deposits in Kenya, the reader is referred to the recent Kenyan Ministry of Natural Resources report on the minerals of Kenya.[5]

Copper.—A small mine at Baragoi on the lower slopes of the Elgeyo Escarpment northeast of Eldoret produced mixed sulfide and carbonate ore from veins and lenses in pre-Cambrian metamorphics. The ore was roasted and leached to produce a metal precipitate, which was melted and cast into ingots at the mine site. Production of copper from Macalders Mine in South Nyanza District stopped in 1966 when the ore was exhausted, except for a small amount done by circulating water from the flooded mine over iron scrap to recover copper leached from the abandoned slopes.[6]

Lead and Silver.—The lead and silver operation at Kinangoni closed down. Operated by Kenya Mining Industries, which is a partnership of the ICDC of Kenya and Geomin of Romania, the mine started operations in 1973 and had mined out 2 million tons of ore. Reserves had been estimated at 5 million tons when mining began. The silver content was recovered at the smelter and ranged from 5% to 6% (750 grams per ton of lead concentrate). Metallurgical, water, and management problems brought about the closure. Underground mining was difficult because the area was very faulted and weathered.

Magnetite.—Magnetite was mined in southeastern Kenya near Ikutha for use in cement manufacture at Mombasa.[7]

NONMETALS

Barite.—In the Kilifi District of the Coast Province, the Vitengeni barite-lead mine continued with small-scale produc-

[5] Du Bois, C. G. B., and J. Walsh. Minerals of Kenya. Kenya Geol. Survey Bull. 11 (Kenya). Ministry of Natural Resources. 1970, p. 11.
[6] Page 13 of work cited in footnote 5.
[7] U.S. Embassy, Nairobi, Kenya. State Department Telegram 12955, Nov. 19, 1976, 1 p.

tion of high-grade barite, most of which was consumed locally. Lead concentrate was being stockpiled. Plans were made to exploit additional barite from the nearby Nyali deposit.[8] The Vitengeni deposit consisted of a system of almost vertical veins up to 30 feet wide over a distance of several miles. The barite was of good white color and assayed 98% to 99.32% $BaSO_4$. Possible reserves were estimated at about 100,000 tons. About 420 tons was produced yearly.

Cement.—Production of cement increased 10% over that of 1975. The East African Portland Cement Co. Ltd. and the Bamburi Portland Cement Co. Ltd. merged under the name of Kenya Cement.[9] Production continued at the Bamburi plant near Mombasa in the Coast Province and the Athi River plant near Nairobi in the Eastern Province. Recent expansion of the Bamburi plant raised capacity from 800,000 tons to 1,250,000 tons per year. The company was also expanding the capacity of the Athi River plant from 250,000 tons to 400,000 tons per year, to be mostly used for local needs. Gypsum for this plant was available 10 miles from Athi River. At yearend, the local price of cement was about $3.25 per 50-kilogram bag. Sudan was a major importer of Kenyan cement.

Diatomite.—Diatomite was produced from several deposits in Kenya. Large deposits occurred in lakebeds of Pleistocene age at several localities in and near the Great Rift Valley. The more important deposits were situated at Kariandus and Elmenteita, both near Gilgil; Gicheru in the Kedong Valley; Eburru; and several localities around Lake Naivasha. Deposits were also located in the vicinity of Lake Magadi at Legamunge and Koora. The Kariandus deposit, which was being actively exploited, contained several bands of diatomite having a wide range in purity. The best had a powder density of 7 to 8 pounds per cubic foot and came from a horizon with a low-grade cover ranging from 45 to 120 feet thick. Partial chemical analysis of the higher-quality diatomite had shown a silica content of 78.2% to 85.2%. The Gicheru deposit was also mined periodically. Reserves of various qualities were large.[10] Tables 4 and 5 show a summary of diatomite deposit characteristics.

Fertilizer Materials.—The U.S.-financed company, Ken-Ren Chemicals and Fertilizers, of Nairobi, was expecting to complete a monoammonium-diammonium phosphate fertilizer plant in Kenya by the second half of 1978. The stamicarbon

[8] Mining Annual Review. Central and East Africa: Kenya. 1977, p. 462.
[9] Industries et Travaux d'Outre-mer (Paris). Afrique de l'Est (East Africa). V. 24, No. 275, September 1976, p. 663.
[10] Page 13 of work cited in footnote 5.

Table 4.—Kenya: Diatomite deposits

Location	Thickness (feet)	Reserves (thousand metric tons)	Quality or powder density (pounds per cubic foot)
Kariandus (Gilgil)	100+	(1)	8.0 (at best)
Gicheru (Kedong Valley)	25	845	13.5
Do	16–37	4,000	25.0
Do	40–80	6,000	43.5
Soysambu (Elementeita)	19	(1)	Good.
Koora Plain (Magadi)	6	(2)	Satisfactory.
Tatham Estate (Eburru)	3	5	12.8
Nderit (Magadi)	9	100	18.0
Gilgil River	7	(2)	26–30
Subukia	(3)	(4)	Doubtful.
Crescent Island (Lake Naivasha)	(3)	(4)	Poor.
Etherington Estate (Naivasha)	2+	(4)	12–15
Legamunge (Magadi)	4+	(2)	22.0
Lake Hotel Naivasha	3+	(2)	Moderate.
Magadi Concession	(3)	600	Poor.

[1] Large.
[2] Unknown.
[3] Thin.
[4] Small.

Source: Du Bois, C. G. B., and J. Walsh. Minerals of Kenya. Kenya Geol. Survey Bull. 11 (Kenya). Ministry of Natural Resources. 1970, p. 19.

Table 5.—Kenya: Chemical analysis of diatomite in selected deposits
(Percent)

	Naivasha [1]	Gicheru (Kikuyu) [2]	Gilgil [1]
SiO_2	73.18	83.14	73.67
Al_2O_3	5.92	2.73	8.32
Fe_2O_3	3.32	1.61	1.10
MgO	.21	.28	1.20
CaO	.65	.38	.48
Na_2O	--	--	.61
TiO_2	.37	.16	.52
Cl	.09	--	--
CO_2	.24	--	--
Moisture	9.86	8.08	8.24
Loss on ignition	4.08	3.84	5.76
Not determined	2.08	--	--
Total [3]	100.00	100.22	99.90

[1] Analyst—East African Industrial Research Organization, Nairobi, Kenya.
[2] Analyst—Mines and Geological Department, Nairobi, Kenya.
[3] Data may not add to totals shown because of independent rounding.

Source: Du Bois, C. G. B., and J. Walsh. Minerals of Kenya. Kenya Geol. Survey Bull. 11 (Kenya). Ministry of Natural Resources. 1970, p. 19.

process plant was to cost about $19.6 million and have a 130,000-ton-per-year capacity. Coppee-Rust S.A.-N.V. of Brussels was the contractor for the plant.

Fluorspar.—The Fluorspar Co. of Kenya Ltd. continued to mine fluorite at its Kerio Valley mine, producing a record high of 75,027 tons valued at $4.9 million in 1976. The new mill was completed in 1975, when the company began production. The company spent a total of $18 million on mine development, including construction of a complete township for 2,800 people, 350 of which were employees. One year and $2 million were spent in constructing a 24-kilometer, all-weather dirt road between the mine and the Government-built tarmacadam road to Eldoret.

Both acid- and metallurgical-grade fluorspar were produced from ore grading 45% to 60% fluorite. The metallurgical grade contained an average of 78% CaF_2 with a maximum of 17% silica. The company had set a target for 1977 of 10,000 tons per month of acid grade and 1,000 tons per month of metallurgical grade.

The acid-grade fluorite had a high phosphorus content making it undesirable for some markets. Research and a microprobe analysis indicated that some of the phosphorus was in the mineral lattice and not easily extractable. The P_2O_5 content ranged between 0.2% and 0.6% in the ore and could not be reduced below 0.1%. Japan canceled its expected contract for 50,000 tons per year because of the high phosphorus content. Production from new low-phosphorus fluorite vein deposits was expected during 1977. The Fluorspar Co. discovered that most of the vein deposits, whether in the older limestones or the overlying Miocene basalts, did not contain high phosphorus in the fluorite lattice, whereas the massive replacement bodies found in the limestone did. The replacement bodies, which were about 120 meters wide, formed the greater part of the minable reserves, estimated at 11 million tons of proven and 10 million tons of probable. One vein deposit in basalt was reported to be 8 meters wide containing about 500,000 tons of minable fluorite. Three vein deposits were being investigated for their production potential.

Transportation costs were about $18 per ton for the 864 kilometers by rail to Mombasa; production costs were about $22 per ton. The company paid a royalty of $0.24 per ton of concentrate, although this payment was not due until capital costs had been fully paid. Fuel costs had increased in the past few years. Exploration costs, however, remained low—about $0.06 per ton of ore. All prospecting was done by trenching. There was little soil or overburden covering the deposits. Fluorite vein deposits were known to occur along the rift zone extending to the Sudanese border.

Graphite.—A graphite deposit of 5 million tons was reported from the Austrian-supported exploration efforts in the Taita-

Taveta region. The small graphite mine located in the Machakos District, 40 miles from Kiboise, was recently closed down, but the deposit was still considered promising by Kenyan authorities.

Kaolin and Kyanite.—An Austrian-supported exploration team reported deposits of exploitable size in the Taita-Taveta region, including 10 million tons of kaolin and 5 million tons of kyanite. The Austrians were to spend $1.4 million on the prospecting effort.[11] Deposits of gem stones were also known in the area. The Kenyan Mines and Geological Department was to receive technical assistance for mineral exploration from the Canadian Government. A development agreement was expected to be signed in March 1977, providing $1.06 million to support exploration over the coastal mineral and gem stone belt, and over selected parts of Nyanza and Western Provinces. Under terms of the agreement, Kenya was to employ a private Canadian firm, Terrasurveys, to carry out airborne magnetic and radiometric surveys.

Magnesite.—Less than 10 tons per year of magnesite has been mined in Kenya since 1974 owing to suspension of the Kinyiki Hill mine operations. New management was expected to renew production. A steel rolling mill company was to mine the magnesite for use in making brick for its mill.

Soda Ash.—The Government was negotiating for capital participation in the Magadi Soda Co. Ltd., but no agreement was reached. Soda ash production was up to 115,214 tons in 1976 in spite of slackened demand. The company had a potential for producing more than 200,000 tons per year. The plant had two kilns, together capable of processing 800 tons of soda ash per day. Reserves in Lake Magadi were calculated to a depth of 10 feet to be 100 million tons. According to company officials, however, the trona appeared to form as quickly as it was mined. The company drilled the lake to a depth greater than 400 feet and found that the soda fluoride and clay contents increased with depth; the best material was in the top 10 to 25 feet. The company had two dredges, one capable of dredging to a depth of 25 feet.

Salt.—Magadi Soda produced two types of salt in large crystals for grinding and refining elsewhere. Red iron oxide was added to the variety made for animal use and iodine (30 to 40 parts per million, as required by the Government) was added to that intended for human consumption. Salt was produced from the liquor associated with the soda deposits in Lake Magadi. The liquor was pumped to evaporating paddocks where it was separated from the sodium carbonate by evaporating techniques, scraped up, washed, and then bagged in 80-kilogram bags. In 1976, Magadi Soda produced 50,000 tons of salt valued at $40 per ton. Salt production, conducted only during the dry season, was usually equal to about 25% of soda ash production.

The Italian firm Saltech International was building a salt refinery in Mombasa.[12] By 1977, the plant was expected to produce salt from Malindi at an initial rate of 50,000 tons per year, to be increased later to 80,000 tons per year.

Stone.—Basement-system limestone was exploited for the manufacture of portland cement at Kabinga, south of Sultan Hamud. Marble was quarried for ornamental stone and lime products near Turoka, Kajiado District. Calcite veins cut carbonatite bodies at Mrima Hill, Coast Region; Homa Hill, South Nyanza District; and Ruri. At the first two localities, the mineral formed white or colorless bladed crystals up to 1 foot in length, which formed radiating clusters. The Ruri calcite tended to be massive in habit. A firm in the Kajiado area produced calcite for Ceramic Industries of East Africa Ltd. for the manufacture of eating utensils.

Vermiculite.—A Japanese company was mining vermiculite from a small deposit located near Samburu near Mt. Kenya. Production of about 100 tons per month started in 1972. The 1976 production of vermiculite was reported as 3,587 tons valued at $755,615.

MINERAL FUELS

Coal.—Coal exploration and drilling continued in the Permian-Triassic Karroo sediments of the Coast Province. No coal

[11] Industries et Travaux d'Outre-mer (Paris). Afrique de l'Est (East Africa). V. 25, No. 281, April 1977, p. 252.

[12] Industries et Travaux d'Outre-mer (Paris). Afrique de l'Est (East Africa). V. 24, No. 275, October 1976, p. 725.

deposits of economic value have been found in Kenya, although there has been intermittent interest in searching those Karroo sediments with a favorable geologic environment.

Petroleum.—Kenya began construction of an oil pipeline that would link the port of Mombasa with Nairobi. Expected to be ready by yearend 1977, the 450-kilometer long, 14-inch diameter pipeline was to be capable of carrying 1 million tons of oil products per year. The pipe will deliver oil, paraffin, and gasoline from East African Oil Refineries, Ltd., at Mombasa to a terminal in the industrial area of Nairobi, where four 4,500-horsepower pump stations are to be built. Three United Kingdom firms and the Japanese firm Nissho-Iwai Co., Ltd., were awarded contracts for pipeline construction. Pencol Engineering Consultants of the United Kingdom was to design and supervise the construction of the pipeline. Ingersoll-Rand Co. Ltd. and Metrotect, also of the United Kingdom, won contracts of $445,000 and $890,000, respectively, for the pipeline's construction. Financing was being arranged through the IDA and Eximbank. The total cost was expected to be $96 million.[13]

Petroleum exploration was relatively low in 1976. Drilling took place in two areas. Chevron Oil Co. and Esso Standard Kenya Ltd. acquired a permit for a 25,000-square-mile concession in 1976, located onshore near the Somali border. Two dry holes were drilled and the concession was released in early 1977. The wells, Anza 1 and Bahati 1, went to 12,015 feet and 11,220 feet, respectively. Texas Pacific Oil Co., Inc., operator for a consortium involving also Whitestone Kenya Petroleum Co. and Louisiana Land & Exploration Kenya Ltd., began drilling about 6 miles southeast of Garissa in late 1975. The hole, Hagarso 1, proved dry at 10,000 feet. On the basis of these drilling efforts, both Chevron and the Texas Pacific consortium suspended virtually all field activity. Chevron abandoned its prospecting license and moved equipment to Sudan for exploration in 1976. In September 1976, Texas Pacific renewed its license until January 1978, but only on a portion of its original southern concession.

Adobe International (including Burmah Oil Kenya Ltd.) renewed its license on two small parts of its previous area in northeastern Kenya. Ocean Exploration Co. Ltd.'s license on an onshore and offshore area in southern Kenya was revoked by the Government in 1976 owing to insufficient activity. Kenya Sun Oil ceased its survey activities in late 1976, and it was anticipated that this license would also be abandoned. Wainoco Kenya and Anschutz Kenya were continuing studies in their offshore area. BP-Shell Petroleum Development Company of Kenya Limited and Total Petroleum Ltd. were negotiating for drilling rights in an offshore area. Phillips Petroleum Co. was authorized to run a seismic survey and was to work in conjunction with the Total group. With the exception of the marine license areas, petroleum exploration in Kenya was expected to cease completely during 1977, as no new bids had been received.[14]

[13] Page 736 of work cited in footnote 12.

[14] U.S. Embassy, Nairobi, Kenya. Status of Oil Exploration in Kenya. State Department Airgram A–108, Dec. 17, 1976, p. 3.

The Mineral Industry of North Korea

By E. Chin [1]

The year 1976 marked the end of the fourth economic development plan (1971–76) initiated by the Government to promote industrialization and modernization and advance overall technology in the country. The Government advanced the completion date of the plan by 1 year to 1975; purportedly, the target levels set for most production sectors were attained. The objectives for 1976, the last year of the current plan, were to sustain the output capacity achieved thus far and prepare the fifth economic development plan for further advances in the economy. The quantitative output goals set for 1980 under the new plan call for doubling coal, fertilizer, and cement production and tripling steel production. Targets of the third and fourth plans and proposed goals for 1980 of the fifth plan were as follows, in million tons, unless otherwise specified:

Sector	1970	1975–76	1980
Iron ore	7.2	NA	NA
Pig iron	2.3	3.5–3.8	NA
Steel:			
Crude	2.2	3.8–4.0	12
Rolled	1.7	2.8–3.0	NA
Nonferrous metals	.16	.45	1
Cement	4.0–4.5	7.5–8.0	20
Fertilizers, chemical	1.5	2.8–3.0	5
Magnesium clinker	NA	1.6	NA
Coal	27.5	50–53	100
Electricity ---billion kilowatt-hours--	16.5	28–30	50

NA Not available.

To sustain a high industrial growth rate, priority was given to fostering technological advances in the mineral extractive industry and in the power and transportation sectors. Significantly, technology had to be imported in the form of hardware. Large deficits were incurred after 1970 owing to imports of complete plants, machinery and transportation equipment, and other manufactures. By yearend 1976, North Korea's external debt was estimated at $1.8 billion, distributed as follows, in millions: Centrally planned economy countries, $800; Western European countries, $710; and Japan, $290. Of this accumulated trade deficit, about $300 million was overdue at yearend, indicating that North Korea had been unable to meet payments on purchase contracts and that its foreign exchange reserves were low. During the year, the Government began to negotiate a repayment formula for its financial obligations.

[1] Physical scientist, International Data and Analysis.

PRODUCTION

North Korea produces a variety of mineral commodities, with anthracite, graphite, magnesite, and tungsten considered to be significant by world production standards. Copper, gold, iron ore, lead, nickel, zinc, apatite, barite, pyrite, talc, and other minerals also were produced. Although North Korea has large reserves of anthracite, petroleum and natural gas have not been discovered. Official mineral production data are not available. However, it was conjectured that output of minerals and metals did not meet the national targets inasmuch as the President's New Year's address stated that industrial production capacity far exceeded industrial production.

Table 1.—North Korea: Estimated production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Cadmium, smelter output ----------tons--	110	110	120
Copper:			
Mine output, metal content ----------	13	13	13
Metal, refined, primary ----------	13	13	13
Gold, mine output, metal content ----------thousand troy ounces--	160	160	160
Iron and steel:			
Iron ore and concentrate ----------	9,400	9,400	9,500
Pig iron and ferroalloys [2] ----------	2,800	2,900	3,000
Steel:			
Crude ----------	2,700	2,900	3,000
Semimanufactures ----------	2,500	2,700	2,800
Lead:			
Mine output, metal content ----------	[r] 120	120	120
Metal, primary ----------	[r] 80	80	78
Silver, mine output, metal content ----------thousand troy ounces--	700	1,600	1,600
Tungsten, mine output, metal content ----------tons--	2,150	2,150	2,150
Zinc:			
Mine output, metal content ----------	[r] 162	160	168
Metal, primary ----------	130	140	138
NONMETALS			
Barite ----------	120	120	120
Cement, hydraulic ----------	[r] 6,000	6,000	6,000
Fertilizer, crude, natural phosphate ----------	400	450	450
Fluorspar ----------	30	30	30
Graphite ----------	75	75	75
Magnesite:			
Crude ----------	[r] 1,500	1,500	1,500
Calcined ----------	[r] 500	500	500
Pyrite and pyrrhotite (including cupreous):			
Gross weight ----------	[r] 610	650	700
Sulfur content ----------	[r] 245	260	280
Salt, all types ----------	[r] 240	540	540
Talc, soapstone, steatite, pyrophyllite ----------	120	130	130
MINERAL FUELS AND RELATED MATERIALS			
Coal:			
Anthracite ----------	31,000	32,000	33,000
Bituminous and lignite ----------	7,900	8,000	8,000
Total ----------	38,900	40,000	41,000
Coke ----------	2,200	2,200	2,500

[p] Preliminary. [r] Revised.

[1] In addition to the items listed, a number of other mineral commodities apparently are produced, but information is inadequate to make reliable estimates of output levels. These include (but are not limited to) antimony, germanium, indium, lithium minerals (lepidolite), manganese ore, mica (phlogopite), molybdenite, monazite, nickel, and/or miscellaneous clays, glass sand, building sand, stone, and gravel.

[2] Includes granulated iron.

TRADE

North Korea's total trade in 1976 was estimated at around $1.5 billion, of which approximately 60% was for imports and the remainder for exports. All foreign trade and transactions are conducted by the Government, although the State has never published for dissemination its foreign trade data. North Korea's chief exports are manufactured goods, with some raw materials and foods. The leading mineral and metal exports include iron ore, pig iron, steel semimanufactures, lead and zinc metal, tungsten concentrate, cement, magnesite, and talc. The country imports machinery and transportation equipment, mineral fuels, foodstuffs, and selected raw materials such as coal, coke, and chromium and manganese ore. North Korea's main trading partners were the People's Republic of China, the U.S.S.R., and Japan.

Table 2.—North Korea: Apparent exports of selected mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Cadmium	78	62	All to U.S.S.R.
Copper and alloys, all forms	467	3,503	All to West Germany.
Iron and steel:			
Iron ore and concentrate	304,533	202,705	All to Japan.
Pig iron and cast iron	r 106,220	141,384	Japan 89,613; U.S.S.R. 41,272; Yugoslavia 10,499.
Ferroalloys	r 2,935	2,886	U.S.S.R. 2,814; Japan 72.
Steel:			
Primary forms	179	5,147	All to Japan.
Semimanufactures	r 112,818	125,642	All to U.S.S.R.
Lead metal including alloys, all forms	42,168	62,620	West Germany 32,215; U.S.S.R. 8,925; Japan 8,490.
Silver, unworked and partly worked value, thousands	$20,068	$20,940	West Germany $13,123; France $4,386; Japan $2,939.
Tungsten metal	NA	3	All to Finland.
Zinc:			
Ore and concentrate	51,795	52,299	Japan 38,641; Yugoslavia 13,558.
Metal including alloys, all forms	r 48,320	56,169	Japan 18,002; U.S.S.R. 16,814; France 9,862.
Other:			
Ores and concentrates	10	--	
Metal-bearing metallurgical residues	2,051	2,808	All to Japan.
Metals, all forms	88	119	West Germany 75; France 20; United Kingdom 10.
NONMETALS			
Barite	r 100,074	94,859	All to U.S.S.R.
Clay, not further identified	966	9,096	All to Japan.
Cement, hydraulic	345,000	500,000	All to U.S.S.R.
Feldspar and fluorspar:			
Fluorspar	8,995	4,350	All to Poland.
Feldspar and fluorspar, undifferentiated	6,371	1,516	All to Japan.
Fertilizer materials, nitrogenous (ammonium-nitrate)	r 15,004	15,426	All to U.S.S.R.
Graphite	20,360	20,356	Japan 19,025; West Germany 823; Austria 508.
Magnesite, including powder	576,868	629,946	U.S.S.R. 394,363; Poland 90,964; Japan 53,133; West Germany 47,116; Netherlands 17,762.
Stone, sand and gravel:			
Unworked:			
Quartz and quartzite	7,845	9,900	All to Japan.
Slate	NA	907	Do.
Granite, sandstone, other noncalcareous stone	1,159	9,469	Do.
Unspecified	18	--	
Worked, dimension stone, all types	565	519	Do.
Talc, soapstone, steatite	r 106,060	119,349	U.S.S.R. 60,000; Japan 44,332; Poland 14,417.
MINERAL FUELS AND RELATED MATERIALS			
Coal and coal briquets	236,764	36,938	All to Japan.

r Revised. NA Not available.

[1] Compiled from import data of Australia, Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France, West Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, the Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, the U.S.S.R., the United Kingdom, the United States, and Yugoslavia.

Table 3.—North Korea: Apparent imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum metal including alloys, all forms	r 1,787	1,923	U.S.S.R. 1,730; Japan 193.
Chromium ore and concentrate	r 11,000	20,000	All from U.S.S.R.
Copper metal including alloys, all forms	80	79	Japan 61; Switzerland 18.
Iron and steel:			
Scrap	290	--	
Pig iron and cast iron	205	1,247	All from Japan.
Ferroalloys	r 6,168	7,148	U.S.S.R. 5,901; Japan 1,247.
Steel:			
Primary forms	2,350	--	
Semimanufactures	r 180,794	37,670	Japan 28,679; U.S.S.R. 6,462.
Manganese ore and concentrate	21,000	20,000	All from U.S.S.R.
Nickel metal including alloys, all forms	--	255	France 155; Finland 100.
Other:			
Oxides, hydroxides, peroxides of metals	3	--	
Metals including alloys, all forms	270	87	All from U.S.S.R.
NONMETALS			
Asbestos	4,572	3,341	Do.
Clay and refractory products	188	10,681	Japan 7,938; West Germany 1,921.
Fertilizer materials, manufactured:			
Nitrogenous	--	15,000	All from Japan.
Potassic	58,311	43,184	All from U.S.S.R.
Mixed	52,969	91,820	Yugoslavia 63,030; West Germany 1,921.
Stone, dimension, worked	1,207	--	
Sulfur, elemental	6,203	5,866	All from U.S.S.R.
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades	228,000	189,000	Do.
Coke	r 108,000	204,000	U.S.S.R. 146,000; Poland 58,000.
Hydrogen, helium, rare gases	27	19	All from Japan.
Petroleum, crude, and refinery products thousand tons	944	1,110	Mainly from U.S.S.R.

r Revised.

[1] Compiled from import data of Australia, Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France, West Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, the Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, the U.S.S.R., the United Kingdom, the United States, and Yugoslavia.

COMMODITY REVIEW

METALS

Iron and Steel.—Production of iron ore and concentrate in 1976 was around 9.5 million tons. About 54% of total production was from the Musan mine, which reportedly has an annual output capacity of 6.5 million tons per year. The bulk of the remainder was from Chaeryŏng, Hasŏng, Kaech'ŏn, Kŏmdŏk, Songhŭng, Sŏngnam, Tŏkhyŏn, Unyul, and Yŏngwŏn. Newly developed mines at Sŏhae-ri and Tŏksŭng produced lesser quantities of iron ore. The mines at Chaeryŏng, Hasŏng, Kŏmdŏk, Songhŭng, Tŏkhyŏn, Tŏksŭng, and Unyul reportedly had completed their expansion programs to increase annual output.

Pig iron production during 1976 was estimated at 3.0 million tons and was by the Ch'ŏngjin steel plant, the Hwanghae iron and steel complex, the Kangsŏn steel complex, and the Kimch'aek iron and steel works, the largest in North Korea. The country's combined annual steel capacity was around 4 million tons. The steel complexes at Hwanghae, Kangsŏn, and Kimch'aek were recently modernized. A new iron and steel complex was being established at Namp'o, designed to have an initial capacity of 1 million tons per year, later to be expanded to 3 million tons per year. Under the fifth economic development plan, crude steel production is to reach 12 million tons in 1980.

Output of steel semimanufactures was estimated at 2.8 million tons. Although most of the production was domestically consumed, about 4% of the output was exported, mainly to the U.S.S.R. North

Korea planned to increase exports of steel products during 1977.

Nonferrous Metals.—Lead and zinc continued to be the principal nonferrous metals produced in North Korea. During 1976, estimated output of lead and zinc was 120,000 tons and 168,000 tons, respectively. The country's lead-zinc smelters are located at Haeju, Namp'o, and Munp'yŏng. A new smelter was reportedly being constructed on the east coast in the Tanch'ŏn area. The bulk of domestic output of lead-zinc ore was from mines at Sŏngch'ŏn and Kŏmdŏk.

About 13,000 tons of refined copper is produced annually from indigenous ore. North Korea also imports around 50,000 tons of 30%-grade copper concentrate from Peru. Small aluminum remelt facilities are located at Chinampo, Hŭngnam, and Tasado. Domestic requirements for aluminum, however, are met by imports, largely from Japan. A primary aluminum smelter of 20,000-ton-per-year capacity was near completion. Metal content of tungsten mine output was around 2,150 tons, about 5.2% of the total world production. North Korea also produces small quantities of cadmium, gold, nickel, and silver.

NONMETALS

Cement.—Production of cement totaled around 6 million tons in 1976. About half of the output was from the Sunch'ŏn cement works; the bulk of the remainder was from plants located at Haeju, Komusan, Kusŏng, Majŏng, Pongsan, and Sŭnghori. The Sunch'ŏn works was nearing completion of an expansion program to double its capacity to 6 million tons per year. Installation of additional kilns at the Haeju cement works reportedly was completed, boosting its capacity to 3 million tons per year. A 5-million-ton-per-year cement plant at Ch'ŏnnae was still under construction. By 1978–79, North Korea's annual cement capacity was expected to be around 15 million tons. Under the fifth economic development plan, the target for cement production in 1980 was set at 20 million tons.

Magnesite.—North Korea continued to be one of the world's largest producers of magnesite. Mine output in 1976 was estimated at 1.5 million tons from mines in South Hamgyŏng and Kangwŏn Provinces. Crude magnesite was beneficiated and sintered at plants at Tanch'ŏn, Songjin, and Ch'ŏngjin for production of dead-burned and caustic calcined grades of magnesium oxide.

Other Nonmetals.—North Korea continued to be one of the world's largest producers of graphite. Output in 1976 was about 75,000 tons, comprising mostly low-grade amorphous material. Production of barite was around 120,000 tons. Much of this material was shipped to the U.S.S.R. under a long-term barter agreement. North Korea also produces significant quantities of fluorspar, pyrite, salt, and talc. Output of natural phosphate for fertilizers was estimated at 450,000 tons. Small- to medium-scale phosphate fertilizer plants are located in almost all of the provinces. Production of chemical fertilizers in 1976 was around 2.8 million tons, of which about 50% was produced at the Hŭngnam fertilizer complex and most of the remainder at the Ch'ŏngsu chemical plant and the Such'on Nitrolime Fertilizer Factory.

MINERAL FUELS

Coal.—North Korea's major mineral commodity and domestically produced fuel source is coal. Output in 1976 was estimated at 41 million tons, below the target set for the fourth economic development plan ending in 1976. About 80% of total output was anthracite consumed locally for space heating. The remainder was bituminous coal that was reportedly of good metallurgical grade. The Chollima Sinch'ang coal mine is the nation's largest producer. Additionally, there are large open cast workings at Yonghŭng. The mines at Kukdong and Yangjŏng were newly opened and were producing more than 1 million tons of coking coal. The mines at Aoji and Kogŏnwŏn were claimed to have produced large quantities of high-grade metallurgical coal. New coal mines were being developed at Tŏkch'ŏn, Kangdon, Kangsŏ, Kowŏn, and other places in South P'yŏngyang Province. Additional coal production came from existing mines at Chiktong, Ch'ŏnsŏng, Huknyŏng, Kaech'ŏn, Kŏmdŏk, Musan, Taedae-ri, Tŏksŏng, Yongdae, and Yongmun.

Petroleum.—There are no known commercial occurrences of oil and natural gas in North Korea. Domestic demand for

petroleum has been met through imports, principally from the People's Republic of China and the U.S.S.R. A pipeline was completed in late 1975 to bring Taching oil from the People's Republic of China to North Korea. Moreover, an oil refinery was being built in the west to process Chinese crude oil and provide naphtha feedstock for a recently constructed petrochemical plant. The oil refinery on the east coast, which reportedly came onstream in 1974–75, presumably handles imports of crude oil from the U.S.S.R.

The Mineral Industry of the Republic of Korea

By E. Chin [1]

During the third 5-year economic development plan, the economy of the Republic of Korea was projected to grow at an average annual rate of 8.6% between 1972 and 1976; in actuality, the economy attained a real annual growth rate of 11.2%. In terms of 1970 market prices, the gross national product (GNP) in 1976 reached 4,758 billion won. At current market prices, the GNP was 12,109 billion won (U.S. $25.0 billion).[2] By sectors, mining and quarrying accounted for only 1% of the GNP in 1976, compared with 30% for manufacturing, 25% for agriculture, forestry, and fishery, 16% for wholesale and retail trade, and 28% for other goods and services.

The mining and quarrying sector grew by 13.5% in current prices over the 1975 level to $273 million in 1976. During the year, the principal sectors reporting increased output were iron ore, tungsten, gold, silver, lead, zinc, talc, cement, petroleum products, iron and steel, and nonferrous smelter products. Decreased mine output was reported for anthracite, copper ore, and fluorite.

Production indexes (1970=100) for the major components of the mining, mineral processing, and metals sector for the last 5 years follow: [3]

	1972	1973	1974	1975	1976
Mining:					
Coal, anthracite	100	110	123	142	133
Metallic ores	90	102	106	112	125
Nonmetallic ores	104	140	149	166	186
Primary metals:					
Iron and steel	130	207	402	429	621
Nonferrous metals	127	151	178	262	378
Industrial chemicals	110	135	152	199	291
Petroleum products	118	139	138	152	171

Inflation continued upward in 1976. Wholesale prices rose 8.9% in 1976, compared with 20.2% in 1975. The curtailment of the escalation in wholesale prices was ascribed to stabilized prices for major imported raw materials, to bumper harvests of major food grains, and to the implementation of the Price Stabilization and Fair Transactions Law during 1976. Consumer prices rose 11.4% in 1976, compared with 25.4% in 1975. The increase in consumer prices was attributed largely to higher costs of foodstuffs. Prices of imported goods were up 7.7%. The increase in wholesale prices of imported goods ranged from 1.8% for fuels, through 11.6% for metals and metallic products, to 51.6% for fibers and fiber products.

During 1976, expansion of construction activities remained generally stagnant owing to a decrease in Government-initiated projects. The Government issued permits for new construction projects totaling 17,985,000 square meters for 111,580 structural units, distributed as follows in square meters: New housing units, 9,494,000; commercial and service structures, 3,240,000; industrial structures, 3,494,000; and educational and other structures, 1,757,000. Included in the industrial structures were plant construction for an 80,000-ton copper refinery, a 50,000-ton zinc refinery, a 10,000-ton methanol plant, a 350,000-ton ethylene plant, and a 230,000-ton polyethylene plant.

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Korean won (W) to U.S. dollars at the rate of W484=US$1.00 for 1976.

[3] The Bank of Korea (Seoul). Economic Statistics Yearbook 1977. June 10, 1977, 325 pp.

In midyear, construction began on an 845-kilometer expressway to link Taegu and Masan, scheduled for completion at yearend 1977. Additionally, the Government undertook road pavement projects covering 1,111 kilometers. During the year, pavement of roads totaling 126 kilometers was completed, bringing the total length of the Nation's paved roads to 3,746 kilometers.

In 1976, ground was broken for the construction of a dam at Taechong, to be completed in 1979. On October 28, 1976, a multipurpose dam at Andong, North Kyonsang Province, was dedicated. By yearend, 28 industrial estates were in existence or being constructed in Korea. Included in these were 2 free export zones (Masan and Iri), 6 export industrial estates, 1 special export industrial estate, 1 special electronics export estate (Kumi), 11 provincial industrial estates, and 4 special industrial estates.

During 1976, overseas construction and engineering contracts totaling $2.5 billion were awarded to Korean firms and were geographically distributed as follows: Middle East, $2.4 billion; Southeast Asia, $24 million; other Pacific areas, $17 million; Africa, $16 million; and Latin America, $14 million. At yearend, 53 domestic firms were engaged in overseas construction projects.

Under an energy development plan (1977–81) drafted in 1976, Korea's total energy demand in terms of coal was projected to increase from 66,585,000 tons in 1977 to 93,135,000 tons in 1981. Domestic demand for coal was projected to increase from 21,760,000 tons in 1977 to 30,291,000 tons in 1981. Demand for oil products was to increase from 37,700,000 tons to 54,694,000 tons. Demand for energy generated from hydropower and atomic sources was to increase from 1,013,000 tons in terms of coal to 2,907,000 tons in 1981, whereas the demand for charcoal would be 6,112,000 tons in 1977 and decrease to 5,243,000 tons in 1981.

Total electric power generation in 1976 was 23.1 billion kilowatt-hours of which 1.8 billion kilowatt hours was from hydrosources and 21.3 billion kilowatt hours was from thermal plants. During the year, 568.7 million kilowatt hours was consumed by 362 mining and quarrying operations, 2.6 billion kilowatt hours by 4,859 chemical firms, 1.8 billion kilowatt hours by 1,273 nonmetal manufacturers, and 2.4 billion kilowatt hours by 8,598 firms fabricating metal products.

In 1976, the total scale of government expenditures for investments and loans was $1.9 billion, of which $40 million was allocated to the mining sector, up 14.1% from the 1975 budget. The manufacturing sector received $206 million; expansion of power generating facilities, $193 million; transportation, $444 million; and other, $1,017 million. On March 30, 1976, Korea drew 55.4 million Special Drawing Rights (SDR's) from the International Monetary Fund (IMF) Oil Facility, which had remained unused from the 1975 ceiling. Korea's aggregate drawings from the IMF Oil Facility totaled 252.7 million SDR's at yearend. During the year, the International Finance Corp. extended a total of $52.7 million in investments and loans to Korea, of which Korea Zinc Co. received $19 million for the construction of a zinc refinery. On March 30, 1976, the State-run Dai Han Coal Corporation concluded a loan agreement for $12 million with the Asian Development Bank for the development of coal mines.

In 1976, Korea had a total of $1.6 billion in foreign loans and investments, distributed as follows: Foreign public loans, $695 million; foreign commercial loans, $852; and foreign investments, $86 million. Out of these totals, extensions to the metal industry by foreign public loans were $2.7 million; foreign commercial loans for the metal industry, $145 million; and foreign investments for mining, $0.3 million.

In May 1976, the Korea Research Institute of Geoscience and Mineral Resources (KIGAM) was founded. The Institute was established to assist the country and its industries in a balanced development of indigenous resources by means of geological research and exploration for minerals, energy, and water resources on land and in adjacent offshore areas. Prime research projects of KIGAM included radioactive mineral exploration for nuclear raw materials, geophysical exploration and experimental drilling for petroleum and natural gas, exploration and delineation of metal and nonmetal mineral resources, a reconnaissance survey for coal, geological mapping, engineering geology, marine mineral development, and fundamental studies and services to support the Institute's prime research projects.

PRODUCTION

The index for mining production in 1976 was 142.6 (1970=100), an increase of 1.7% over the 1975 index. The decline in production levels for coal, copper ore, kaolin, fluorite, and agalmatolite was offset by increased output of iron ore, tungsten, gold and silver, lead and zinc ore, and talc. In terms of value, the mining of anthracite dominated the mineral economy of the Republic of Korea. In 1976, 16.4 million tons of anthracite, valued at $326 million, was produced. Production of limestone was 19.1 million tons and was used primarily in cement manufacture. Total output of cement during the year was 11.9 million tons. Mine production of zinc ore was 118,271 tons, and output of lead ore was 29,066 tons. Production of tungsten ore was 4,660 tons (gross weight) and constituted around 8% of the world's output. The Republic of Korea continued to be one of the world's leading producers of graphite. However, production of amorphous graphite decreased 15% to 38,277 tons in 1976.

Production of primary aluminum metal, all from imported alumina, totaled 17,605 tons. Smelter output of copper, mostly from imported material, was 29,741 tons. Production levels of lead and zinc and other nonferrous metals were generally higher in 1976.

There was no domestic production of oil and natural gas. Total petroleum refinery input in 1976 was 132.4 million barrels. Output from refining operations increased over production during 1972–75. Production of residual fuel oil increased 10%, and production of distillate fuel oil increased 23%. Refinery outputs of jet fuel, kerosine, and gasoline were above the 1975 yield.

Table 1.—Republic of Korea: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum metal, primary	17,671	18,000	17,605
Antimony, mine output, metal content	--	--	119
Arsenic, mine output, white arsenic equivalent	16	e r 100	709
Bismuth, metal	131	113	174
Cerium, metallic	80	e 90	--
Copper:			
Mine output, metal content	r 2,794	2,671	2,255
Smelter	12,400	20,300	29,700
Metal, refined, including secondary	12,399	20,928	29,741
Gold, metal ---troy ounces	r 23,792	13,343	18,744
Iron and steel:			
Iron ore and concentrate, gross weight ---thousand tons	r 625	644	755
Pig iron ---do	987	1,186	1,937
Ferroalloys ---do	34	21	35
Crude steel (excluding castings) ---do	1,935	2,010	2,698
Lead:			
Mine output, metal content	r 10,499	12,164	14,533
Metal, smelter	4,606	5,739	7,762
Manganese ore and concentrate, gross weight	2,107	3,160	1,383
Molybdenum, mine output, metal content	r 76	76	120
Rare-earth metals, monazite concentrate, gross weight e	10	10	10
Silver, metal ---thousand troy ounces	r 1,291	1,504	1,858
Tin, mine output, metal content	10	4	35
Titanium, ore and concentrate, gross weight	160	e 160	e 160
Tungsten, mine output, metal content	r 2,328	2,444	2,587
Zinc:			
Mine output, metal content	r 40,734	45,919	59,136
Metal, primary	11,548	20,922	27,222
Zirconium concentrate, gross weight	40	e r 20	--
NONMETALS			
Asbestos	5,710	4,345	4,762
Barite	745	2,062	4,174
Cement, hydraulic ---thousand tons	8,842	10,129	11,873
Clays, kaolin	271,812	298,264	249,040
Diatomaceous earth	11,688	19,285	13,483
Feldspar	24,617	20,138	26,208

See footnotes at end of table.

Table 1.—Republic of Korea: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
NONMETALS—Continued				
Fertilizer materials, manufactured:				
Nitrogenous (urea)	thousand tons	812	925	846
Phosphatic (magnesium phosphate)	do	173	189	148
Mixed	do	652	715	774
Fluorspar, metallurgical grade		r 32,981	28,296	20,270
Graphite:				
Crystalline		1,660	2,339	3,413
Amorphous		103,201	44,893	38,277
Kyanite and related materials, andalusite		115	106	520
Lime, slaked e	thousand tons	r 95	r 100	110
Mica, sericite		2,700	e 3,000	5,314
Pyrite, gross weight		1,635	1,664	1,632
Sodium compounds, sodium carbonate, manufactured		97,028	127,103	155,457
Stone, sand, gravel:				
Crushed and broken limestone	thousand tons	14,572	16,904	19,099
Quartzite	do	325	265	298
Sand (including glass sand)	do	261	262	301
Sulfur, content of pyrite		491	499	490
Talc and related materials:				
Pyrophyllite		r 328,418	322,967	348,694
Talc		r 113,674	92,907	147,774
MINERAL FUELS AND RELATED MATERIALS				
Carbon black		16,539	23,884	32,290
Coal, anthracite	thousand tons	r 15,263	17,593	16,427
Coke	do	600	613	1,103
Fuel briquets, anthracite briquets e	do	11,000	11,000	11,000
Peat e		4	4	4
Petroleum refinery products:				
Gasoline	thousand 42-gallon barrels	4,416	4,173	5,332
Jet fuel	do	4,038	4,251	4,958
Kerosine	do	2,459	3,946	4,244
Distillate fuel oil	do	18,411	20,816	25,628
Residual fuel oil	do	58,868	62,380	68,354
Other	do	12,574	19,407	17,368
Refinery fuel and losses	do	8,655	2,742	6,523
Total	do	109,421	117,715	132,407

e Estimate. p Preliminary. r Revised.

TRADE

Overall trade for the Republic of Korea in 1976 was close to $16.5 billion; imports were about $8.8 billion, compared with exports of $7.7 billion. By area, shipments between other Asian countries constituted close to 40% of the total value of the Republic of Korea's trade, followed by North America, the Middle East, Europe, and other. Japan and the United States, in that order, remained the top trading partners in 1976.

By major commodity groups, exports in 1976 was constituted as follows, in million dollars: Food and animal stock, 510; beverages and tobacco, 78; inedible crude materials, 196; mineral fuels and related materials, 144; chemicals, 119; manufactured goods, 5,365; machinery and transport equipment, 1,280; and other, 23. Imports during 1976 were distributed as follows in million dollars: Foodstuffs, 690; beverages, 30; inedible crude materials, 1,565; fuels, 1,747; chemicals, 847; manufactures, 1,479; machinery, 2,387; and other, 10.

Imports of crude petroleum totaled about 135 million barrels, valued at $1.6 billion. Domestic receipts of mineral products in 1976 were about $91.4 million. Exports of major mineral items in 1976 were as follows, in million dollars: Tungsten, 42.6; zinc ore, 8.2; talc, 5.5; kaolin, 5.1; agalmatolite, 3.6; silica, 3.2; silver concentrate, 3.1; lead ore, 2.5; graphite, 1.9; bismuth concentrate, 1.3; and gypsum, 1.2.

Table 2.—Republic of Korea: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, all forms	6,948	595
Bismuth metal including alloys	67	149
Chromium:		
Ore and concentrate	17	--
Oxides and hydroxides	--	1
Cobalt metal including alloys, all forms	42	--
Copper:		
Ore and concentrate	--	(1)
Metal including alloys, all forms	1,088	440
Iron and steel:		
Ore and concentrate, thousand tons	76	62
Scrap, do	1	13
Pig iron, ferroalloys, and similar materials, do	r 19	11
Steel, primary forms, do	157	218
Semimanufactures:		
Bars, rods, angles, shapes, sections, do	154	246
Universals, plates, sheets, do	750	351
Hoop and strip, do	14	(1)
Rails and accessories, do	(1)	1
Wire, do	13	10
Tubes, pipes, fittings, do	206	100
Castings and forgings, do	37	17
Total, do	1,174	725
Lead:		
Ore and concentrate	7,638	6,710
Metal including waste and sweepings	11	44
Molybdenum:		
Ore and concentrate	75	52
Trioxide	5	10
Metal	(1)	--
Nickel metal	12	1
Platinum-group metals and silver:		
Ore and concentrate	3,350	3,200
Metal including alloys, thousand troy ounces	r 14,203	1,244
Selenium	3	(1)
Tin:		
Ore and concentrate	33	22
Metal including alloys, all forms	8	2
Titanium oxide	30	--
Tungsten:		
Ore and concentrate	r 2,898	--
Metal including waste and scrap	1	26
Uranium and thorium metals including alloys, all forms, kilograms	4,990	--
Zinc:		
Ore and concentrate	54,474	47,620
Oxide	866	266
Metal including alloys, all forms	r 434	330
Other:		
Ores and concentrates of nonferrous metals n.e.s	6	--
Ash and residue containing nonferrous metals	131	320
Base metals including alloys, all forms, n.e.s	84	65
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum	43	21
Grinding and polishing wheels and stones	22	32
Asbestos	301	124
Barite	--	45
Cement and clinker	1,950	2,439
Chalk	1,250	2
Clays and clay products:		
Crude clays, n.e.s.:		
Kaolin	164,092	109,340
Other	32,674	40,944
Products:		
Refractory	360	449
Nonrefractory	r 60,190	50,881
Diamond:		
Gem, not set or strung, thousand carats	r 56,565	165,000
Industrial, do	335	10
Diatomaceous earth	82	70
Feldspar	r 11,850	6,668
Fluorspar	9,776	10,730
Other	r 341	492

See footnotes at end of table.

Table 2.—Republic of Korea: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS—Continued		
Fertilizer materials:		
Crude	265	210
Manufactured: Nitrogenous	--	1
Ammonia	10	--
Graphite, natural	60,959	35,500
Gypsum and plasters	253,570	66,470
Mica, all forms	r 3,576	1,900
Pigments, mineral, processed iron oxides	503	35
Precious and semiprecious stones, except diamond, including synthetic kilograms	114,742	53,731
Salt	475	138
Sodium and potassium compounds, n.e.s	2,068	20,274
Stone, sand and gravel:		
Dimension stone	r 107,782	60,748
Dolomite, chiefly refractory grade	24,150	93,150
Gravel and crushed stone	9,375	9,023
Limestone	161	240
Quartz and quartzite	221,214	114,236
Sand, excluding metal bearing	13,209	13,316
Talc, crude and ground (including natural steatite)	49,691	42,212
Other nonmetals, n.e.s.:		
Crude:		
Other	203,851	176,682
Slag, dross and similar waste, not metal bearing	38,055	56,242
Building materials of asphalt, asbestos and fiber, cement, and unfired nonmetals n.e.s	7,769	10,835
Oxides, hydroxides, and peroxides of strontium, barium and magnesium	250	10
MINERAL FUELS AND RELATED MATERIALS		
Coal, coke and peat	25,250	1
Petroleum:		
Crude thousand 42-gallon barrels	39	--
Refinery products:		
Gasoline	1,627	910
Kerosine	598	593
Distillate fuel oil	1,195	1,661
Residual fuel oil	949	925
Lubricants	127	397
Other	2,850	3,561
Total	7,346	8,047
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	3,524	34,602

r Revised.
1 Less than ½ unit.

Table 3.—Republic of Korea: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite and concentrate	510	800
Oxide and hydroxide:		
For use in manufacturing aluminum	34,379	32,605
Other	9,546	9,167
Metal including alloys, all forms	27,597	23,568
Arsenic: Trioxide, pentoxide, acid	42	3
Beryllium metal including alloys, all forms ---kilograms--	16	92
Chromium oxide and hydroxide	718	514
Cobalt:		
Oxide and hydroxide	5	8
Metal including alloys, all forms	8	3
Copper:		
Ore and concentrate	21,834	29,030
Matte	240	73
Metal including alloys, all forms	r 39,285	35,015
Iron and steel:		
Ore ---thousand tons--	1,395	1,494
Metal:		
Scrap ---do--	1,120	844
Pig iron, ferroalloys, similar materials ---do--	96	78
Steel, primary forms ---do--	1,090	564
Semimanufactures:		
Bars, rods, angles, shapes, sections ---do--	198	241
Universals, plates, sheets ---do--	304	285
Hoop and strip ---do--	87	38
Rails and accessories ---do--	43	11
Wire ---do--	7	14
Tubes, pipes, fittings ---do--	28	32
Castings, and forgings, rough ---do--	(1)	(1)
Total ---do--	667	621
Lead:		
Ore and concentrate	1,138	--
Oxides	153	215
Metal including alloys, all forms	13,916	8,312
Magnesium metal including alloys, all forms	288	103
Manganese:		
Ore and concentrate	56,168	47,550
Oxide and hydroxide	718	713
Mercury ---76-pound flasks--	909	920
Molybdenum metal including alloys, all forms	6	8
Nickel:		
Matte, speiss, and similar materials	50	35
Oxide and hydroxide	(1)	1
Metal including alloys, all forms	2,001	1,006
Phosphorus, elemental	65	25
Platinum-group metals and alloys ---troy ounces--	17,201	32,601
Rare-earth metals, including alloys	r 9	4
Selenium, elemental	1	1
Silicon, elemental	92	142
Silver ---thousand troy ounces--	1,900	377
Tantalum metal, all forms	3	--
Tin:		
Ore and concentrate	12,594	10
Oxides	(1)	(1)
Metal including alloys, all forms	715	1,073
Titanium:		
Ore and concentrate:		
Rutile	1,456	1,675
Ilmenite	18,469	5,222
Oxides	2,204	3,087
Tungsten metal including alloys, all forms	15	7
Uranium and thorium metals including alloys, all forms ---kilograms--	15	--
Vanadium pentoxide ---do--	271	1,730
Zinc:		
Ore and concentrate	2,074	--
Oxide	397	267
Metal including alloys, all forms	21,356	5,757
Zirconium ore and concentrate	477	180
Other:		
Ore and concentrate of base metals, n.e.s	77	86
Ash and residue containing nonferrous metal	520	470
Metals including alloys:		
Metalloids	1	2
Pyrophoric alloys	1	(1)
Base metals including alloys, all forms, n.e.s	53	100

See footnotes at end of table.

Table 3.—Republic of Korea: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	962	688
Dust and powder of precious and semiprecious stones including diamond ----kilograms--	4,077	5,321
Grinding and polishing wheels and stones	276	330
Asbestos	64,849	56,960
Barite	--	906
Boron materials:		
Crude natural borates	55	80
Oxide and acid	497	875
Bromine	(1)	1
Cement, hydraulic	57,946	1,817
Clays and clay products (including all refractory brick):		
Crude clays n.e.s	16,527	11,867
Products:		
Refractory (including nonclay bricks)	343,883	53,544
Nonrefractory	r 214	95
Cryolite	3	--
Diamond, industrial ----thousand carats--	r 10,750	125
Diatomite and other infusorial earth	148	15
Fertilizer materials:		
Crude phosphatic	562,270	1,516,510
Manufactured:		
Nitrogenous	8,473	24,204
Phosphatic	130,683	172,516
Potassic	206,191	332,369
Other, including mixed	53	2,540
Ammonia	1,800	2,144
Fluorine, elemental	1	(1)
Graphite, natural	25	1
Gypsum and plasters	1,737	718
Iodine	4	5
Lime	5	36
Magnesite, crude, calcined, magnesia clinker	40	5
Mica, all forms	207	191
Pigments, mineral, including processed iron oxides	45	96
Precious and semiprecious stones, except diamond including synthetic ----kilograms--	r 61,236	72,084
Pyrite, unroasted	7,503	4,583
Salt	261,315	311,581
Sodium and potassium compounds, n.e.s	r 25,930	13,111
Stone, sand and gravel:		
Dimension stone, crude and partly worked	263	234
Dolomite, chiefly refractory grade	242	145
Gravel and crushed rock	93	--
Limestone	69,310	15,742
Quartz and quartzite	75	84
Sand, excluding metal bearing	11,726	189
Sulfur:		
Elemental	213,688	228,336
Sulfur dioxide	5	11
Sulfuric acid	50	39
Talc, steatite, soapstone, pyrophyllite	18	33
Other nonmetals, n.e.s.:		
Crude	2,395	2,777
Slag, dross and similar waste, not metal bearing	522	1
Oxides, hydroxides, and peroxides of magnesium, strontium, barium	231	2,144
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	121	157
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	34	54
Carbon black and gas carbon	3,225	2,887
Coal, all grades, including briquets	773,415	671,494
Coke and semicoke	65,362	114,618
Gases, rare	112	97
Helium	17	4
Petroleum:		
Crude and partly refined ----thousand 42-gallon barrels--	104,223	121,856
Refinery products:		
Gasoline	12	16
Kerosine	13	31
Distillate fuel oil	27	70
Residual fuel oil	2,124	2,799
Lubricants	210	496
Other	452	405
Total	2,838	3,817
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	20,387	30,582

r Revised.
1 Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—Production of primary aluminum metal in 1976 was 17,605 tons, valued at $19.1 million. Total metal output was by Aluminum of Korea, Ltd. (Koralu) at its Ulsan smelter, using alumina imported from Japan. Koralu, a 50–50 joint venture of the Korean Industrial Bank and Péchiney Ugine Kuhlmann (France), has an annual production capacity of 18,000 tons of aluminum metal. The company was planning to expand its smelter capacity in two stages: 38,000 tons by 1977–78, and 72,000 tons by 1979. However, the Government has not given approval for the expansion program owing to power cost subsidies. Korea's demand for aluminum metal is currently close to 60,000 tons per year.

Copper.—Production of copper concentrate in 1976 was 15,030 tons, averaging 15% copper. The Kumpuk copper mine at Kyunsang Nando accounted for the bulk of the Nation's copper ore output. During the year, total production of electrolytic copper was 29,741 tons. The Changhang smelter, owned by Korea Mining & Smelting Co., Ltd., produced 22,135 tons of copper metal. The capacity of the Changhang smelter was being expanded to 37,700 tons per year of copper metal. The current annual demand for copper metal was estimated at 45,000 tons. Imports supplied about 20% of Korea's copper requirements and Korea Mining imported 67,599 tons of copper concentrate during 1976.

In September 1976, a contract was awarded to a European consoritum composed of Davy Power Gas, Ltd. (United Kingdom), Outokumpu Oy (Finland), and Sybetra S.A. (Belgium) for the construction of an 80,000-ton-per-year copper smelter-refinery at the nonferrous metals industrial complex being developed at Onsan. Construction began on the copper facility late in the year and was expected to be completed by March 1979.

Iron and Steel.—Mine production of iron ore was around 755,000 tons in 1976, compared with 644,000 tons 1975. Nearly half of the domestic mine output was from the Yangyang mine in Kangwon Province operated by the Dai Han Iron Mining Co., Ltd. Total domestic production constituted about 30% of Korea's requirements for iron ore.

Production of pig iron in 1976 totaled 1.9 million tons, compared with 1.2 million tons in 1975. Close to 90% of the pig iron output was by Pohang Iron and Steel Co., Ltd. (POSCO); the remainder was by Dongkuk Steel Mill Co. (Dongkuk) and Inchon Iron Works Co. Crude steel production in 1976 was 2.7 million tons, compared with 2.0 million tons in 1975. POSCO produced about two-thirds of the crude steel output; Pusan Iron and Steel Co., Dongkuk, and Kuck Dong Steel Co. accounted for the remainder.

In May 1976, POSCO completed the second-stage expansion of its integrated iron and steel facility at the Pohang Industrial Estate in Yeong-il County, Gyeongbug Province. The capacity to produce crude steel was increased to 2.6 million tons from 1.03 million tons. In October 1976, ground was broken for construction of blast furnace No. 3. When the furnace is completed in 1979, POSCO's capacity will be 5.5 million tons of steel per year.

Lead.—Production of lead concentrate during the year totaled 29,066 tons, grading 50% lead. Young Poong Mining Co., Ltd., accounted for virtually all of the country's mine lead output from mines at Yeonhua, Boonpyong, and Ulgen. Production from the No. 1 and No. 2 mines at Yeonhua accounted for 17,531 tons of lead concentrate, or about 60% of the total domestic output. Young Poong Mining was expanding the mill capacity at Yeonhua whereby its annual capacity to produce lead concentrate would be increased by about 25%.

The Changhang smelter of the Korea Mining & Smelting Co., the sole producer of lead metal in Korea, produced 7,762 tons of pig lead. Young Poong Mining was planning a 50,000-ton-per-year smelter at the nonferrous metals industrial estate at Onshan. Construction was expected to begin in 1978.

Tungsten.—Total production of tungsten concentrate, averaging 70% WO_3, was 4,660 tons. The Sangdong mine of Korea Tungsten Mining Co., Ltd., produced the bulk of the country's tungsten output. The remainder was distributed as follows, in tons: Chungyang Co., 145; San-Nae, 78; Okbang Mining Co., Ltd., 64; Wol-Ak, 53; Sam

Yang, 37; Ssangjon, 26; Daewha, 22; Sudo, 11; and other, 34. The mill at Sangdong can process 2,000 tons of ore per day; the concentrate produced is shipped to Korea Tungsten's plant at Taegu where it is processed to produce tungsten powder, carbide, and ammonium paratungstate. Data on the production of metal, powder, carbide, and ammonium paratungstate were not reported. However, the value of exports of tungsten carbide and powder during 1976 was $1.6 million and $4.8 million, respectively. The total value of exports of all forms of tungsten was reportedly around $42.6 million. Korea's production of tungsten constitutes about 8% of total world output.

Zinc.—Production of zinc concentrate containing 50% zinc, wholly by the three mines of Young Poong Mining Co., Ltd., was 118,271 tons in 1976. Output from the Yeonhua mines accounted for about 77% of the zinc mined during the year. Production of zinc metal increased 30% in 1976 to 27,222 tons.

Construction continued on the 80,000-ton-per year Bonghwa zinc smelter of Korea Zinc Co. at Onsan. This project is a joint venture between Young Poong Mining and Toho Zinc Co., Ltd. The Bonghwa facility was expected to be onstream in late 1978. On November 13, 1976, the International Bank for Reconstruction extended to Korea Zinc $19 million, repayable in 8 years at an interest rate of 10.75%. Total cost of the project was estimated at $71.3 million, of which $39 million was to be financed by foreign capital and the remainder by domestic funds.

Other Metals.—During 1976, 174 tons of bismuth metal was produced as a by-product of tungsten processing by Korea Tungsten Mining Co., Ltd. Production of silver metal totaled 1.9 million troy ounces. The bulk of the output was by the Changhang smelter of Korea Mining & Smelting, 963,212 troy ounces, and the Boonpyong operations of Young Poong Mining, 771,624 troy ounces. The country's output of gold was 18,744 troy ounces. Close to 65% of the total production was from Korea Mining's Changhang smelter. Output of 40% manganese ore was 1,383 tons, and molybdenite output was 120 tons. Mine production of other metal ores during the year included minor amounts of antimony, arsenic, and tin.

NONMETALS

Cement.—Cement production by 10 plants of 7 companies totaled 11.9 million tons. During 1976, Asia Cement Manufacturing Co., Ltd., and the Hanil Cement Manufacturing Co., Ltd., completed expansion of their plants at Jecheon and Danyang. Tong Yang Cement Manufacturing Co., Ltd., expanded production at its Samch'ok plant from 1.0 million tons to 2.6 million tons per year at a cost of $22.8 million. The Export-Import Bank of the United States and the Republic of Korea provided financing for the project. All the equipment and machinery was supplied by Fuller Co. Part of the added plant output was to be stockpiled for export to certain member nations of the Organization of Petroleum Exporting Countries, with which cement clinker would be traded for oil.

Total cement manufacturing capacity was 14.9 million tons at yearend 1976, compared with 11.9 million tons at yearend 1975, and was distributed as follows, in thousand tons:

Company and plant location	Capacity
Asia Cement Manufacturing Co., Ltd., Chen'on	1,885
Hanil Cement Manufacturing Co., Ltd., Tanyang	2,485
Hyundai Cement Co., Tanyang (2 plants)	1,200
Korea Cement Co.:	
Changsong	660
Mun-gyong	480
Ssangyong Cement Industries Co., Ltd.:	
Tonghae	2,900
Yeongweol	1,700
Sungsin Cement Co., Tanyang	1,000
Tong Yang Cement Co., Samch'ok	2,600
Total	14,910

Ssangyong Cement awarded a European consortium a contract for expanding its Tonghae plant from 2.9 million tons to 5.6 million tons per year, making the operation one of the largest production facilities in the world when completed in mid-1979. The contract calls for planning, delivering, and installing equipment valued at $125 million. An option for a further expansion phase valued at $65 million was also included. Because of the good transportation network and distribution terminals at Ulsam, Pusan, and Masan, the Tonghae plant will supply the demand on the east coast and interior of South Korea as well as provide cement for export markets.

During the fourth 5-year plan, cement production was expected to reach 23 million tons per year by 1978–80. Domestic consumption was estimated to range between 13 million to 16 million tons per year. The surplus production would be available for export.

Fertilizer Materials.—Production of urea was 845,540 tons in 1976, compared with 924,666 tons in 1975. Chinhae Chemical Co., Ltd., Hankook Fertilizer Co., Ltd., Yong-Nam Chemical Co., Ltd., and Korea General Corp. produced urea fertilizers. Production of compound fertilizers totaled 774,001 tons and was by Chinhae Chemical Co., Ltd. and Yong Nam Chemical. Kyunki Chemical Co., Ltd., and Pungnong Chemical Co., Ltd., produced 147,622 tons of fused magnesium phosphate. Ammonium sulfate was produced by Han Kook Caprolactam Corporation and by POSCO.

Namhai Chemical Co., a subsidiary of the Korea General Chemical Corporation, was constructing a large-scale compound fertilizer plant at Yeocheon, Jeonnam Province. This facility, which will have an annual production capacity of 635,000 tons of urea and 330,000 tons of compound fertilizers, was scheduled for completion in 1978.

Other Nonmetals.—Due to greater demand for cement, limestone production increased 13% to 19.1 million tons in 1976. Output of silica sand and silica stone was 261,952 tons and 265,468 tons, respectively. Production of kaolin clay decreased 16% to 249,600. Production of talc and pyrophyllite was 147,774 tons and 348,694 tons, respectively. Production of other nonmetallic minerals during 1976 follows, in tons: Marine salt 691,000; amorphous graphite, 38,277; crystalline graphite, 3,413; feldspar, 26,208; fluorite, 20,270; diatomaceous earth, 13,483; asbestos, 4,762; barite, 4,174; and andalusite, 520.

MINERAL FUELS

Coal.— *Anthracite.*—Mine production of anthracite in 1976 was 16.4 million tons, valued at $326 million. Virtually all of the production was domestically consumed, primarily for space heating. The Government-owned Dai Han Coal Corporation produced 28% of the country's anthracite output. The remainder of the production was by private companies. The largest private producer is San Chang Coal Co., Ltd., which operates the Samchuk mine.

During the year, the Government released a total of $7.6 million from its facility fund for coal mine development. On March 30, 1976, the Asian Development Bank, approved a $12 million loan to the Dai Han Coal Corporation for 15 years at 8.75% interest. During the year, Dai Han imported the following equipment needed for the modernization of its coal mines: Machine tools and safety devices, $7.04 million; miscellaneous mining equipment, $1.90 million; and test drilling equipment, $0.55 million.

Petroleum.—The Republic of Korea imports all of its oil requirements, mostly in the form of crude petroleum. In 1976, 18.3 million tons of crude oil was imported, valued at $1.6 billion. In 1976, the domestic demand for oil products was estimated at 130 million barrels. Consumption by product type follows, in million barrels: Gasoline, 5.0; kerosine, 4.5; light oil, 25.6; bunker "C" oil, 66.7; heavy oil, 2.1; jet fuel, 4.4; naphtha, 14.8; solvents, 0.4; liquid propane gas, 0.8; and asphalt, 0.9.

Three refineries account for Korea's daily capacity of 435,000 barrels per day: Korea Oil Corp. at the Ulsan petrochemical complex, 215,000 barrels per day; Kyong-In Energy Company at Inchon, 60,000 barrels per day; and Honam Oil Co. at Yosu, 160,000 barrels per day. Kyong-In Energy proposed plans to double the capacity of its refinery at Inchon. Iranian Oil Co. and a local group composed of Ssangyang business interests were planning a 100,000 barrels-per-day refinery at Onsan in Kyongsang Province. Another group, composed of Saudi Arabian and Japanese interests, proposed a new refinery at Ulsan, with a capacity of 150,000 barrels per day.

The oil discovery at Pohang about 200 miles southeast of Seoul stirred a great deal of interest in early 1976, but the commerciality of the discovery was not revealed. Oil exploration offshore was virtually at a standstill, because all concession holders have drilled only dry holes and because of disputed territorial claims.

The Mineral Industry of Kuwait

By David E. Morse [1]

The economy of Kuwait, a small nation of 1 million people at the northwest end of the Persian Gulf, was based on income derived from the sale of crude oil and refined petroleum products. Crude oil production was controlled by the State-owned Kuwait Oil Co., Ltd. (KOC). The KOC oil refinery at Mina Al Ahmadi and the Shuaiba oil refinery operated by the Kuwait National Petroleum Co. (KNPC), also Government-owned, represented 75% of the nation's total petroleum-refining capacity. Kuwait's fiscal year had been a 12-month period beginning April 1 and ending March 31 until fiscal year 1975–76, a 15-month transition fiscal year that ended June 30, 1976. Succeeding fiscal years were to begin July 1 and end June 30. During the 15-month fiscal year 1975–76, revenues from oil were $12.17 billion,[2] or 89% of all Government revenues.

During calendar year 1976, oil receipts were $9.3 billion. Government revenues in recent years have increased dramatically; revenue for the first quarter of 1976 exceeded total revenues for fiscal year 1973–74, owing to the Government's full acquisition in 1975 of KOC and the higher crude oil prices instituted by the Organization of Petroleum Exporting Countries (OPEC). In addition, investment revenue during 1976 increased to $1.1 billion. Government expenditures were $3.2 billion, and Government revenues exceeded expenditures by $7.6 billion during the year.[3]

The high level of income has allowed the Government to undertake a wide range of domestic and foreign economic programs. The Government planned to spend several hundred million dollars to double electricity generation capacity to 2,618 megawatts and increase water desalinization output to 110 million gallons per day. Major public works projects included port expansion at Shuaiba and Shuwikh, highway modernization and extension, four new hospitals, new public housing, greater distribution of fresh water, a new State mosque, and a zoo. Domestic projects devoted to petroleum-related industries included the Kuwait Gas Utilization Project, expansion of ammonia and urea facilities, plants to produce aromatic hydrocarbons, petroleum refinery expansion, and a melamine plant. Kuwait's economic boom has had some negative effects, such as port congestion, increased pollution owing to expanded industry, and labor shortages. The Government continued to assess the viability of industrial projects, especially in the petrochemical field, owing to the building of large plants by other oil-producing nations in the Persian Gulf area.

Kuwait continued to invest considerable sums outside the country and had foreign assets of approximately $17 billion in 1976. The Government provided important economic assistance to Egypt, Jordan, and Syria. Kuwaiti firms increased activities outside the developed nations and invested in joint ventures in Malaysia, Mauritania, Peru, Sudan, Venezuela, and the Yemen Arab Republic. The Governments of Kuwait and Romania began negotiations on a $1 billion joint venture petrochemical complex to be built near Navordari on the Black Sea. Kuwait was to have a 49% share in the venture and supply 160,000 barrels of crude oil per day to Romanian refineries.

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Kuwaiti dinars (KD) to U.S. dollars at the rate of KD1 = US$3.4487.

[3] U.S. Embassy, Al-Kuwait, Kuwait. State Department Airgram A–77, Aug. 31, 1977, encl. 2, p. 1.

The former Kuwait-Saudi Arabia Neutral Zone has been partitioned since 1969. The northern half is administered by Kuwait and the southern half by Saudi Arabia. However, the petroleum concessions in the former Neutral Zone were not affected by the partition agreement. During 1976 in the partitioned Neutral Zone, Arabian Oil Co., Ltd. (AOC) was the offshore concessionaire for both Kuwait and Saudi Arabia, American Independent Oil Co. (Aminoil) was the onshore concessionaire for Kuwait, and Getty Oil Co. was the onshore concessionaire for Saudi Arabia. Petroleum has been the only mineral product obtained both onshore and offshore in the partitioned Neutral Zone, and the two countries have shared the revenue from the production of crude oil.

PRODUCTION

During 1976, Kuwait's crude oil production capacity was greater than 4 million barrels per day; total crude oil output averaged 2.15 million barrels per day, including Kuwait's share of production from the partitioned Neutral Zone. KOC increased output 4.3%, but Kuwait's share of production from AOC's and Aminoil's fields in the partitioned Neutral Zone decreased 5.4%. Crude oil production ranged from 1.4 million barrels per day in April to over 3 million barrels per day in December. Output for the fourth quarter averaged 2.9 million barrels per day because importing nations stockpiled crude oil in anticipation of a January 1977 price increase. Kuwait's oil output had declined steadily since its peak in 1972 because of the Government's policy of maintaining oil prices and controlling the rate of production (1976 planned output was to average 2 million barrels per day), but the 1976 output had an overall increase of 3.1% owing to the large fourth quarter demand of the international market.

In the partitioned Neutral Zone, AOC produced an average of 307,800 barrels per day from the offshore Khafji and Hout Fields, and Aminoil produced an average of 80,000 barrels per day from onshore fields.

During 1976, associated natural gas production in Kuwait averaged 1,083 million cubic feet per day, an increase of 3.4% over 1975 output. Over 61% of the natural gas output was utilized domestically, the highest percentage in the Middle East.

Output of urea fell 4% below 1975 production, and ammonium sulfate production was discontinued owing to slumping prices. In 1976, sales of sand-lime brick, cement, and cement products increased 41% in value.

Table 1.—Kuwait: Production of mineral commodities

Commodity		1974	1975	1976 p
NONMETALS				
Clay products, nonrefractory: Sand-lime bricks	cubic meters	166,121	170,477	213,553
Fertilizer materials, manufactured, nitrogenous:				
Ammonium sulfate	metric tons	126,286	93,042	--
Ammonia, anhydrous	do	508,000	522,750	514,000
Urea	do	516,590	554,551	530,591
Lime, hydrated and quicklime	do	513	136	12,301
Salt	do	12,626	18,057	15,426
Sodium and potassium compounds, caustic soda	do	6,549	8,203	NA
Sulfur:				
Elemental petroleum byproduct	do	53,890	60,483	61,188
Sulfuric acid	do	98,000	84,963	5,000
MINERAL FUELS AND RELATED MATERIALS				
Gas, natural:				
Gross production [1]	million cubic feet	466,939	382,367	395,775
Marketed production [1]	do	r 186,894	183,792	197,120
Natural gas liquids:				
Natural gasoline	thousand 42-gallon barrels	r e 5,650	4,532	5,305
Liquefied petroleum gas (propane and butane)	do	r e 14,500	12,876	14,543
Total	do	r e 20,150	17,408	19,848
Petroleum:				
Crude [1]	do	r 929,678	761,634	785,656
Refinery products: [2]				
Motor gasoline	do	25,157	21,128	30,704
Jet fuel	do	1,406	7,992	4,250
Kerosine	do	8,540	1,057	3,311
Distillate fuel oil	do	23,998	23,659	34,382
Residual fuel oil	do	84,634	50,576	62,806
Other:				
Naphtha	do	4,904	4,383	--
Asphalt	do	1,610	408	390
Unspecified	do	--	14,153	15,981
Refinery fuel and losses	do	3,618	10,225	9,875
Total	do	153,867	133,581	161,699

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Includes Kuwait's one-half share of production in the former Kuwait-Saudi Arabia Neutral Zone.

[2] Includes Kuwait's share of refinery output by its concessionaires in the former Kuwait-Saudi Arabia Neutral Zone.

TRADE

Kuwait's exports were dominated by the activities of the petroleum industry. During 1976, Kuwait exported 656 million barrels of crude oil and 147 million barrels of refined petroleum products, including liquefied petroleum gas. Petroleum exports maintained their 93% share of the export market, although the value of all exports increased 14% and the value of nonpetroleum exports increased 25% over 1975 values. Crude oil was exported mainly to the Far East (46%) and Europe (41%); Japan and the United Kingdom were the largest customers. In 1976, Brazil was the largest importer of Kuwaiti crude oil in the Western Hemisphere (4.4%). The value of nonpetroleum exports and reexports was overshadowed by the magnitude of the value received from petroleum, but has become substantial; chemical fertilizers, manufactured from domestic raw materials, were a significant portion of the nonpetroleum exports. The value of all exports during the year was approximately $10.2 billion.

At $3.3 billion, 1976 imports increased 38% over the 1975 value. Main imports were transport equipment, machinery, food and live animals, and manufactured goods. Kuwait's prime sources of imports were Japan, the United States, the Federal Republic of Germany, the United Kingdom, and France.

Table 2.—Kuwait: Exports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, unwrought and semimanufactures	40	146
Copper metal including alloys, unwrought and semimanufactures	48	18
Iron and steel metal:		
Scrap	72,072	18,864
Pig iron, ferroalloys, similar materials	1	--
Semimanufactures	r 43,404	73,254
Lead metal including alloys, unwrought and semimanufactures	19	218
Tin metal including alloys, unwrought and semimanufactures	4	[2]
Zinc, blue powder	154	--
Other:		
Nonferrous metal scrap	6,438	4,946
Metal including alloys, all forms	[2]	--
NONMETALS		
Abrasives, natural, n.e.s.: Grinding and polishing wheels and stones	10	5
Cement	1,146	33,443
Clays and clay products (including all refractory brick):		
Crude clays, bentonite	32,520	22,717
Products:		
Refractory (including nonclay bricks)	24	40
Nonrefractory	[3] 1,088	597
Diamond ---carats	500	50
Fertilizer materials:		
Crude	60	218
Manufactured:		
Nitrogenous	670,668	653,503
Other including mixed	120	5
Ammonia	144,290	123,815
Gypsum and plasters	40	20
Lime	--	75
Salt (excluding brine)	733	268
Sodium and potassium compounds:		
Caustic soda	4,055	28,303
Soda ash	2	69
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	267	--
Worked	291	126
Gravel and crushed rock	1,174	1,173
Sand	7,715	13,722
Sulfur:		
Elemental, all forms	16,484	1,991
Sulfuric acid	5,514	6,141
Other crude nonmetals	86	50
MINERAL FUELS AND RELATED MATERIALS		
Petroleum:		
Crude ---thousand 42-gallon barrels	828,716	674,634
Refinery products:		
Shipments other than bunkers:		
Gasoline ---do	20,543	17,372
Kerosine and jet fuel ---do	8,556	6,981
Distillate fuel oil ---do	19,556	18,865
Residual fuel oil ---do	44,339	39,663
Other ---do	22,073	18,592
Total ---do	115,067	101,473
Bunkers:		
Distillate fuel oil ---do	488	818
Residual fuel oil ---do	24,572	14,739
Total ---do	25,060	15,557

r Revised.
[1] Includes Kuwait's share of former Kuwait-Saudi Arabia Neutral Zone exports of petroleum.
[2] Less than ½ unit.
[3] Revised from none.

Table 3.—Kuwait: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, unwrought and semimanufactures	891	3,192
Copper metal including alloys, unwrought and semimanufactures	r 558	506
Iron and steel metal:		
Scrap	9,942	5,828
Pig iron, ferroalloys, similar materials	137	191
Semimanufactures:		
Bars, rods, angles, shapes, sections	189,710	187,564
Universals, plates, sheets	75,674	81,064
Wire	3,251	2,830
Tubes, pipes, fittings	36,942	30,403
Lead metal including alloys, unwrought and semimanufactures	1,012	895
Nickel metal including alloys, unwrought and semimanufactures	--	(1)
Silver and platinum ---troy ounces	686	(1)
Tin metal including alloys, unwrought and semimanufactures	4	10
Uranium, radium, and thorium and their alloys ---value	$66,227	$63,725
Other:		
Nonferrous metal scrap, not subdivided	980	1,872
Metals including alloys, unwrought and semimanufactures	28	409
NONMETALS		
Abrasives, natural, n.e.s.: Grinding and polishing wheels and stones	117	206
Asbestos	5,405	5,666
Bentonite	50,176	38,685
Cement	871,000	699,116
Clays and clay products:		
Crude, earth for cement manufacture	--	11,537
Products:		
Refractory (including nonclay bricks)	1,314	785
Nonrefractory	21	2,683
Diamond, gem, not set or strung ---carats	28,600	3,940
Fertilizer materials:		
Crude, natural, all types	29	17
Manufactured including mixed	122	228
Ammonia	2	47
Graphite	1,148	19
Gypsum and plasters	16,304	15,789
Lime	729	5,937
Precious and semiprecious stones, except diamond ---kilograms	134	146
Salt	6,230	4,523
Sulfur, sulfuric acid	81	97
Stone, sand and gravel:		
Dimension stone:		
Unworked:		
Marble	4,777	2,195
Mosaic stones, pebbles, powder	46,302	51,906
Other	3,353	3,842
Worked	11,123	18,796
Gravel and crushed stone	6,425	574
Sand	3,331	1,552
Sodium and potassium compounds:		
Caustic soda	2	195
Soda ash	409	193
Other:		
Agricultural soil and clay	44	158
Unspecified crude minerals, chalks, colored soil, clay	582	1,040
MINERAL FUELS AND RELATED MATERIALS		
Coal and coke including briquets	r 884	187
Hydrogen, helium, rare gases	14	65
Petroleum refinery products: [2]		
Gasoline:		
Aviation ---thousand 42-gallon barrels	7	2
Motor ---do	19	--
Kerosine ---do	3	--
Lubricants ---do	222	76
Other ---do	r 196	--
Total ---do	r 447	78

r Revised.
[1] Less than ½ unit.
[2] International Petroleum Annual, Division of Petroleum and Natural Gas, U.S. Bureau of Mines, 1974 and 1975.

COMMODITY REVIEW

NONMETALS

Cement.—The Kuwait Cement Co. (KCC) produced cement from gypsum and clinker imported from Iraq. During 1976, KCC increased capacity to 300,000 tons per year and increased sales $7 million. The company planned to install new facilities to increase production capacity to 1 million tons per year in 1978 and to 1.3 million tons by 1980. KCC reached a preliminary agreement to produce cement and clinker in Oman and signed an agreement to set up a 3-million-ton-per-year plant in Saudi Arabia. Kuwait was to take 1,000 tons per day of cement and 4,000 tons per day of clinker from the Saudi project.

Construction Materials.—National Industries Co. (NIC) was the primary domestic manufacturer of building materials in Kuwait. In 1976, the company expanded the capacity of its sand-lime brick facilities from 60 million to 150 million brick per year. A new 156-million-brick-per-year sand-lime brick plant in southern Kuwait was to be in full production by the end of 1977. Two asbestos plants were to be built in the Mina Abd Allah area to expand asbestos products production by 35,000 tons per year. In 1976, NIC sales increased 43% in value.

Fertilizer Materials.—Petro Chemical Industries Co., owned by the Government, produced ammonia, urea fertilizer, and sulfuric acid, and halted ammonium sulfate production during 1976. Petro Chemical's urea output declined 4.3% in 1976 owing to slackened world demand for fertilizers and a temporary shutdown caused by severe weather and sandstorms in April. Production of ammonium sulfate at the 160,000-ton-per-year facility was discontinued because of low demand and the poor price in the world market. Most of NIC's fertilizer output was exported to Persian Gulf States and to Eastern Asia.

MINERAL FUELS

Natural Gas.—Kuwait produced natural gas only in association with crude oil, and output was dependent on the rate of crude oil production. The Dorra gasfield offshore in the partitioned Neutral Zone, the only known field of nonassociated natural gas, had not been developed for commercial use. AOC completed one well during 1976 and was drilling another at yearend in the Dorra gasfield. Estimated natural gas reserves in Kuwait were 37 trillion cubic feet at yearend 1976, a 2.1% decrease from those of yearend 1975. Natural gas was used for reinjection into oilfields, electric power generation, water distillation, fertilizer raw material, and general use. Total estimated natural gas reserves in the partitioned Neutral Zone were 19 trillion cubic feet at yearend 1976, a 3.8% decrease from that of yearend 1975. Most of the natural gas produced in the partitioned Neutral Zone during the year was flared.

Kuwait utilized 61.6% of its 1976 natural gas output and embarked on a course to make use of all natural gas production. The Kuwait Gas Utilization Project was to come to fruition in 1978 and produce 5.5 million tons per year based on a crude oil output of 3 million barrels per day, or 3.6 million tons per year if crude oil output is restricted to 2 million barrels per day. KOC was entrusted with overseeing the $875 million project and plans to test the Permian Kuff formation, which produces nonassociated natural gas in the partitioned Neutral Zone, Saudi Arabia, and Bahrain. A 20,000-foot test well in the Burgan Field was scheduled for 1977, and the Kuff was expected to be tapped near 16,000 feet. A source of nonassociated natural gas was desired to reduce the project's dependence on inconsistent crude oil production. Kuwait Oil Tanker Co. ordered four gas tankers with a capacity of 71,650 cubic meters each that are to be put in the service of the project. Delivery of the gas tankers was expected in 1978 and 1979.

Petroleum.—Seven wells were completed in Kuwait during 1976. KOC completed five oil wells during the year, although no drilling was reported during 1975. KOC's 1976 output came from 587 flowing wells; the bulk of production was from the Burgan-Magwa-Ahmadi complex. Kuwait Spanish Petroleum Co., a joint effort of KNPC and Hispanoil (Spain), completed two wildcat wells in 1976, the last of a seven-well $20 million exploratory program. All wells were dry, and Hispanoil

relinquished its concession rights in October 1976. Offshore in the partitioned Neutral Zone, AOC completed four oil wells in the Khafji Field and one oil well in the Hout oilfield, and was drilling another well in the Khafji Field at yearend. AOC drilled 12 wells in 1975 and 20 wells in 1974. AOC's 1976 output came from 123 wells in the Khafji Field and 25 in the Hout Field; most of the output was from the high-sulfur Khafji Field. Offshore production capacity was 350,000 barrels per day in 1976. Onshore in the partitioned Neutral Zone, Aminoil/Getty did not report any drilling activity and production came from 10 flowing and 298 artificially lifted wells in the Wafra, South Fawares, and South Umm Gudair Fields. Onshore production capacity was 200,000 barrels per day in 1976.

Crude oil reserves were estimated at 69,500 million barrels in Kuwait and 6,500 million barrels in onshore and offshore fields in the partitioned Neutral Zone.

Kuwait's production of refined petroleum products was exported except for approximately 17,000 barrels per day consumed by the domestic market. Kuwait was served by three petroleum refineries with a combined daily throughput capacity of 645,000 barrels. The Shuaiba oil refinery (KNPC) operated at 90% of capacity and provided petroleum products for domestic and foreign customers during the year. The export-oriented refinery at Mina Al Ahmadi (KOC) operated at 35% of rated capacity, an increase of 22,000 barrels per day over 1975 production. The Aminoil oil refinery at Mina Abd Allah continued to operate at approximately 58% of capacity in 1976 despite a December 1975 fire that caused extensive damage to the refinery's desulfurization unit. KNPC installed a new 42,000-barrel-per-day hydrocracking vessel at the Shuaiba oil refinery late in 1976. The new unit and hydrogen production facilities were scheduled to come onstream in September 1977. KNPC awarded an $8 million contract to Shell Oil Co. and a local contractor to build a 28,000-ton-per-year lubricating-oil blending plant at Shuaiba. Foster Wheeler Italiana received a $12 million contract from KOC to build a 200,000-ton-per-year asphalt plant, to be completed in 1977.

The Mineral Industry of Liberia

By Janice L. W. Jolly [1]

The mineral industry of Liberia in 1976 consisted primarily of the production of iron ore and diamond. Some gold, cement, and refined petroleum products were also produced. Iron ore production was cut back during the first half of 1976 when the declining demand of 1975 continued. The sluggish demand had led to a stockpile of nearly 5 million tons at the ports of Buchanan and Monrovia by yearend 1975. By yearend 1976, however, demand had improved so that an overall 13% gain over the 1975 volume of iron ore exports was achieved. Industrial diamond production declined 7.0% from that of 1975. Despite the drop in revenues derived from these principal income earners, Liberia achieved a foreign trade surplus of $61 million,[2] and its foreign exchange position was measurably improved. The gross domestic product (GDP) for 1976 was estimated at $863 million, up 9.7% from that of 1975 at current prices and representing a 2.5% growth in real terms.

The 1976 budget provided for expenditures and revenues of $129.9 million, representing an increase of $12.9 million over the 1975 budget. The Government changed to a fiscal year beginning July 1 and implemented a new 4-year development plan on July 1, 1976. Emphasis was to be on rural development with most expenditures on infrastructure improvement. In the first year, development projects costing $73.1 million were to be started. Total costs for the 4 years were estimated at $415 million. Liberia was to finance 38% of the plan, while foreign donors were to provide 62%. Road construction was to receive $126 million. A cement factory was also included in the plans.[3]

Liberia and Sierra Leone were well on their way to fusing their economic systems in a full common market.[4] After months of negotiations, the two countries agreed to harmonize all customs duties. The Mano River Union Secretariat, the body charged with integrating the economies, was approved in 1973 by the joint Council of Ministers. All that remained was approval by the Liberian Legislature and assent by the respective heads of state. The new tariff was to come into effect by April 1, 1977. The Economic Community of West African States (ECOWAS) reached agreement on several items dealing with financial contributions from the 11 member States and how they should be operated and managed. Location of headquarters and selection of the secretary general were yet to be decided.

Thirty or forty foreign firms expressed an interest in establishing manufacturing facilities in Monrovia's Industrial Free Zone (IFZ). Work on the IFZ's infrastructure was to start in 1977. To protect their investments and to obtain favorable treatment, most investors were to have some Liberians as shareholders. Corporations were required to be incorporated in Liberia.

Terms of mineral concessions were usually negotiated on a case-by-case basis. Each application for a mineral concession was to be made in writing to the Ministry of Lands and Mines. If the ministry was satisfied with technical aspects of the proposal and with the applicant, the applica-

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[1] Physical scientist, International Data and Analysis.
[2] Liberia uses U.S. dollar currency.
[3] Washington Star. Liberia Hoping To Be Showpiece for the U.S. Mar. 20, 1977, p. B-8.
[4] The Financial Times (London). Sierra Leone, Liberia Link. Feb. 19, 1977, p. 11.

tion was forwarded to the concession secretariat in the Ministry of Finance for further evaluation. The secretariat then made its recommendation to the Concession and Investment Commission, which forwarded the application to the President, who then sent it to the Legislature for approval. The entire process took as little as 3 weeks. The mining concessions were to comply with the Investment Incentive Code as amended in 1974. The Code was originally set by a law enacted in 1966.

Electrical production in 1975 was 860 million kilowatt-hours, resulting in an average annual increase from 1970 to 1975 of 6.4%. Energy consumption per capita was 432 kilograms in coal-equivalent kilograms. Steel consumption was 27,000 tons.[5]

PRODUCTION AND TRADE

Iron ore production in the first half of 1976 was 11.0 million tons, a 23% drop from that of the last 6 months of 1975. Bong Mining Co., Ltd. (BMC), was the largest producer for the second consecutive 6-month reporting period with 4,425,159 tons in the first half of 1976. Liberian American-Swedish Minerals Co.-Joint Venture (LAMCO–JV) produced 4,264,030 tons; National Iron Ore Co., Ltd. (NIOC), 1,390,938 tons; and Liberia Mining Co., Ltd. (LMC), 876,842 tons in the first half of 1976.

Liberia's total export earnings for 1976 were $460 million, up 13.4% from the amount earned in 1975. Iron ore exports for 1976 were 20.5 million tons, valued at $331.6 million, up 12.9% in value from the $293.6 million earned in 1975 for 18.1 million tons exported. The volume of iron ore exports fell during the last half of 1975 and the first half of 1976 as sales and demand declined. The volume of iron ore exports increased nearly 8% in the third quarter of 1976, however, as demand began to pick up at yearend. The average price per ton had increased over 115% since 1973 to about $16.20 in 1976. Diamond exports in 1976, valued at $16.6 million for 320,000 carats shipped, were down 9.8% in value from the $18.4 million received in 1975 for 420,014 carats. Iron ore and diamonds together made up 76% of the total export value in 1976. At the time of this report, no figures were available on the value of gold exported. Total imports (c.i.f.) in 1976 were valued at $399.2 million, up 20.5% from the 1975 import value of $331.2 million.[6]

During the first half of 1976, 2,136,049 barrels of crude oil were imported from Saudi Arabia by the Liberia Refining Co. (LRC). In the same period, 4,622 barrels of motor gasoline and 68,983 barrels of petroleum distillate were imported. Mobil Oil (Liberia) Inc. was the sole importer of aviation gasoline, which amounted to 4,895 barrels imported from the United States. Total petroleum imports for 1975 were valued at $40.7 million. Liberia exported 16,036 barrels of motor gasoline to Guinea and 2,943 barrels of liquefied petroleum gases to Sierra Leone in the first 6 months of 1976.

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[5] To the Point International (Belgium). Africans at a Glance. Mar. 7, 1977, pp. 24–25.

[6] U.S. Embassy, Monrovia, Liberia. Economic Trends Report for Liberia. 1977, 7 pp.

Table 1.—Liberia: Production of mineral commodities

Commodity [1]		1974	1975	1976 [p]
METALS				
Gold [e]	troy ounces	3,000	3,000	3,000
Iron ore	thousand metric tons	23,785	[e] 24,000	18,814
NONMETALS				
Cement, hydraulic	do.	86	[e] 90	[e] 100
Diamond: [2]				
Gem	thousand carats	377	221	148
Industrial	do.	259	185	172
Total	do.	636	406	320
MINERAL FUELS AND RELATED MATERIALS				
Petroleum refinery products:				
Gasoline	thousand 42-gallon barrels	507	549	326
Jet fuel	do.	259	282	258
Kerosine	do.	81	75	79
Distillate fuel oil	do.	1,351	1,253	1,309
Residual fuel oil	do.	1,527	1,555	1,498
Other	do.	28	30	21
Refinery fuel and losses	do.	254	218	208
Total	do.	4,007	3,962	3,699

[e] Estimate. [p] Preliminary.
[1] In addition to the commodities listed, a variety of crude construction materials such as clays, stone, sand, and gravel were produced, but available data are inadequate to make reliable estimates of output levels.
[2] Exports.

Table 2.—Liberia: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	1	--	
Iron and steel:			
Ore and concentrate --thousand tons--	25,592	18,401	West Germany 2,050; Italy 1,385; Netherlands 1,203; United States 916.
Semimanufactures	87	19	Ghana 14; Nigeria 3.
Other, nonferrous metal scrap --value--	$299,490	$600,481	Norway $352,874; Spain $74,800; Italy $64,151.
NONMETALS			
Abrasives, natural, grinding and polishing wheels and stones, n.e.s	[1]	--	
Cement	344	654	Cape Verde Islands 454; Equatorial Guinea 199.
Diamond, industrial --carats--	635,723	420,014	Belgium-Luxembourg 235,602; United Kingdom 93,633; Israel 78,922.
Fertilizer, manufactured, nitrogenous	25	--	
Salt	22	10	All to Guinea.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline --42-gallon barrels--	10,234	11,173	Do.
Kerosine --do--	292	31	Do.
Distillate fuel oil --do--	728	--	
Lubricants [2] --do--	452	185	Sierra Leone 106; Ivory Coast 79.
Nonlubricating oil --value--	--	$3,937	United States $3,175; Ivory Coast $762.

[1] Less than ½ unit.
[2] Does not include quantity valued at $4,361 in 1975 (all to Sierra Leone).

Table 3.—Liberia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Oxide and hydroxide	r 1	282
Metal including alloys, all forms	r 519	474
Arsenic trioxide, pentoxide, acid	1	10
Chromium oxide and hydroxide	--	1
Copper metal including alloys, all forms	45	35
Iron and steel metal:		
Scrap	20	--
Pig iron, ferroalloys, and similar materials	26	1,645
Steel, primary forms	435	198
Semimanufactures:		
Bars, rods, angles, shapes, sections	3,960	3,610
Universals, plates, sheets	7,782	4,318
Hoop and strip	15	19
Rails and accessories	814	2,241
Wire	72	44
Tubes, pipes, fittings	2,732	3,324
Castings and forgings, rough	385	1,388
Lead metal including alloys, all forms	59	54
Mercury ---------- 76-pound flasks	--	3
Nickel metal including alloys, all forms	2	8
Platinum-group metals and silver:		
Metal including alloys:		
Platinum group ---------- troy ounces	1	--
Silver ---------- do	158	--
Tin metal including alloys, all forms	2	11
Zinc metal including alloys, all forms	16	9
Other:		
Ore and concentrate of nonferrous base metals ---------- value	$152	$951
Nonferrous metal scrap ---------- do	--	$1,140
Oxides, hydroxides, and peroxides of metals, n.e.s	18	1
Metals including alloys, all forms:		
Metalloids	8	(1)
Alkali, alkaline-earth, and rare-earth metals, n.e.s	36	1
NONMETALS		
Abrasives, natural, n.e.s.:		
Grinding and polishing wheels and stones	218	86
Other ---------- value	$9,500	--
Asbestos	5	15
Boron materials, oxide and acid	(2)	100
Cement	49,103	53,377
Clays and clay products (including all refractory brick):		
Crude clays, n.e.s	19,860	23,550
Products:		
Refractory (including nonclay brick) [3]	102	284
Nonrefractory [4]	1,014	725
Diamond, gem ---------- carats	272	--
Fertilizer materials:		
Natural:		
Nitrogenous	3,962	6,429
Phosphatic	3	351
Potassic	167	--
Manufactured:		
Nitrogenous	34,359	14,163
Phosphatic	3,618	592
Potassic	2,902	468
Other including mixed	3,205	565
Ammonia	1,938	1,661
Gypsum and plasters	10	1,008
Lime	1,912	1,480
Magnesite	--	1
Mica, worked	(1)	(1)
Salt	4,319	2,998
Sodium and potassium compounds, n.e.s.:		
Caustic soda	1,911	1,320
Caustic potash, sodic and potassic peroxides	20	7
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	1,653	653
Worked ---------- value	$65,547	$39,431
Dolomite, chiefly refractory grade	15,599	44,639
Gravel and crushed rock	8,175	33,209
Sand, excluding metal bearing	165	1,975
Sulfur:		
Elemental (includes unroasted pyrites)	1	7
Sulfuric acid	290	113

See footnotes at end of table.

Table 3.—Liberia: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity		1974	1975
NONMETALS—Continued			
Other nonmetals, n.e.s.:			
Crude		$5,795	$126
Oxides and hydroxides of magnesium, strontium, barium		2	1
Bromine, iodine, fluorine		--	(1)
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s.	value	$810,758	$736,965
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		24	36
Carbon black		5	1
Coal and coke including briquets		5,952	5,570
Hydrogen and other rare gases	value	$8,870	$17,075
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	4,374	3,788
Refinery products:			
Gasoline	do	6	4
Kerosine and jet fuel	do	5	(1)
Distillate fuel oil	do	(1)	(1)
Residual fuel oil	do	5	(1)
Lubricants [5]	do	143	77
Other:			
Liquefied petroleum gas	value	$1,712	$8,356
Mineral jelly and wax	thousand 42-gallon barrels	1	(1)
Nonlubricating oils, n.e.s.	value	$39,777	$104,744
Other	do	$62,585	$91,815
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		r 32	36

r Revised.
[1] Less than ½ unit.
[2] Value only reported at $1,392.
[3] Excludes quantity valued at $20,532 in 1974 and $58,390 in 1975.
[4] Excludes quantity valued at $21,554 in 1974 and $69,925 in 1975.
[5] Excludes quantity valued at $159,726 in 1974 and $15,170 in 1975.

COMMODITY REVIEW

METALS

Gold.—Several U.S. companies were interested in gold exploration in Liberia and had applied for concessions near Zwedru. Azuza Mining Corp., Afro-American Mining Corp., and the Liberia Gold and Diamond Corp. were continuing their exploration efforts in southern Liberia.

Iron Ore.—The Liberian Iron and Steel Corp. (LISCO), American Metals Climax (AMAX), and a group of Japanese companies, including Kawasaki Steel Corp., C. Itoh & Co., Ltd., Nissho-Iwai Co., Ltd., Marubeni Corp., and Toyo Menka Kaisha, Ltd., were to sign a supplementary agreement with the Liberian Government for the Wologisi iron ore project by early 1977. The new agreement was to stipulate a royalty of 1% on sales for the first 10 years and a royalty of 2% thereafter.[7] Royalty payments were not to be credited toward meeting income tax obligations. Twenty percent of the Wologisi project shares were being reserved for Liberian investors. The remaining problems of financing and finding markets for the ore were yet to be solved. The project was scheduled to start in 1983. AMAX was to arrange iron ore delivery contracts. Estimates for financing had been raised to $1.6 billion. Annual production of 10 million tons of iron oxide pellets was to be transported by a 137-mile slurry pipeline to a new port to be constructed 9 miles southeast of Robertsport. Technical studies by the Bechtel Corp. on the Wologisi iron ore deposit, scheduled for completion in 1975, had not been completed by yearend 1976.

Negotiations were in progress on the Guinean Iron Mining Co. (MIFERGUI) project that was set up in 1973 to mine the iron deposits located on the Guinean–Liberian border. Liberia had already signed an agreement for its participation in the MIFERGUI–Nimba joint venture and paid $50,000 for a 5% equity participation. Liberia had also approved transit of the Guinean ore through Liberia. However, it was expected that Guinea would

[7] Financial Times (London). Liberia Signs Big Iron Deal. Feb. 10, 1977, p. 28.

have to invest about $100 million in the rail extension from Nimba to Guinea, double tracking of 90% of the railroad track, and expansion of the port facilities at Buchanan, which were considered inadequate to handle the additional tonnage. The Nigerian Government was the largest foreign shareholder in MIFERGUI–Nimba with 13.5%.

Liberian Iron Ore Ltd. (LIO) reported that its net income for the first 9 months of 1976 fell 37.1% to $13,770,000 from $21,900,000 earned for the same period in 1975 on equity in earnings by its 50%-owned LAMCO. LAMCO's net profits for this period were down 38.4% from $42 million in 1975. The reduction in profits was due to substantially increased operating costs as well as to a 1.3% drop in sales. LAMCO–JV was operating at 60% capacity owing to slackening demand in the first half of 1976, but had resumed full production by January 1977 as a result of renewed demand. LAMCO decided to defer implementation of its large Tokadeh project. It was proceeding, however, with installation of additional crushing facilities at Buchanan to meet increased world market demand for fines.

BMC was the largest producer of iron ore in the last half of 1975 and the first half of 1976, although the company had curtailed production to respond to reduced demand and the subsequent large stockpile.[8] The West Germany-based European Coal-Steel Co. was to loan Liberia $35 million to boost production at the Bong mine.[9] Construction was in progress on a second pelletizing facility and improvements to the beneficiating plant at BMC, where an 11th concentrating line was being added. The new installations were to start up in mid-1977. BMC's projected capacity was 7.5 million tons, consisting of 4.8 million tons of pellets and 2.7 million tons of concentrates. In the first half of 1976, BMC produced 4,425,159 tons.

In 1976, LMC produced 1,547,267 tons of iron products from its Bomi Hills mines.[10] The Bomi Hills operation was to close on March 31, 1977, with all shipments completed during the year. Exports totaled 1,921,776 tons in 1976, comprising 790,235 tons of blast furnace ore, 579,556 tons of concentrates, and 551,985 tons of fines. LMC and NIOC had begun negotiations for the Bie Mountain iron ore mining concession.

NIOC solved the problems at its Mano River II mine, and production increased to 1,390,938 tons for the first half of 1976. A Ralph M. Parsons Co. subsidiary was sued for $50 million plus interest and recovery of $725,000 in payments by NIOC. The suit charged Parsons-Jurden Corp. with errors in performance in the engineering contract for their ore-processing facility.

Liberia became the 11th member of the Association of Iron Ore Exporting Countries in 1976. There were no new developments on the Putu iron ore project in Grand Gedeh County, where a Japanese-West German consortium was doing technical studies.

MINERAL FUELS

Petroleum.—The LRC refinery (owned 67% by Sun Oil Co.) was closed for repairs for 3 to 4 months after a fire caused by bursting pipes resulted in damage to the crude-processing unit in December 1976. The furnace was to be replaced.

[8] Skillings' Mining Review. Liberian Iron Ore in First Half of 1976. Jan. 8, 1977, p. 26.
[9] Africa Report (New York). Loans, Grants and Credits, Liberia. September–October 1976, p. 35.
[10] Skillings' Mining Review. Liberian Iron Ore. Feb. 26, 1977, p. 5.

The Mineral Industry of Libya

By Candice Stevens [1]

The oil industry continued to dominate the Libyan economy, accounting for more than 50% of the 1976 gross domestic product (GDP) of $14.5 billion.[2] Increased Governmental participation in the petroleum sector owing to past nationalization measures resulted in a growth in Government oil revenues to nearly $8 billion in 1976. The Libyan oil policy had as its goals maximizing the income per barrel by increasing prices and tax rates; expanding the activities of the State-owned National Oil Corporation (NOC); utilizing oil and gas revenues to develop other sectors of the economy; and developing the national oil sector (exploration, production, refining, petrochemicals, and gas exploitation).

By law, 15% of Libya's oil revenues were to be set aside as Government reserves each year, 15% were designated for the general budget, and 70% were to be devoted to development projects. The current 5-year plan (1976–80) envisaged a total expenditure of about $24 billion. The emphasis was on economic diversification, particularly the development of transportation, electrification, and industrial projects outside of the oil sector. An aluminum smelter and a large iron and steel complex utilizing domestic iron ore resources were to be financed with the aid of Yugoslavia. Cement production capacity was to undergo a major increase, and two new facilities were to make Libya self-sufficient in ammonia fertilizers.

Installed electrical power in Libya increased from 276 megawatts in 1970 to 2,380 megawatts in 1976, and was to undergo further expansion. Two new desalination and electrical powerplants to come onstream at Tripoli and Tobruk were part of a $675 million plan to build similar plants throughout the country. In 1975, the U.S.S.R. agreed to build a 440-megawatt nuclear powerplant in Libya; in March 1976, Libya signed an agreement with France for the supply of a 600-megawatt nuclear powerplant.

The petroleum sector had low priority in Libya's development plans, receiving less than 10% of the allocations of the current 5-year plan. Nevertheless, new projects were undertaken with the assistance of foreign companies on which Libya remained dependent for exploration, marketing, and management of existing fields and installations. Oil production was to be expanded, refining capacity was to be doubled by the construction of five new facilities, and the petrochemical industry was to be supplemented by plants for the production of methanol and ethylene.

PRODUCTION

Libya's petroleum production was again on the upswing in 1976, increasing 31.0% from 540 million barrels in 1975 to 707 million barrels. The upsurge in oil production narrowed the gap between the outputs of Libya and Africa's largest producer, Nigeria. Libya's natural gas production rose substantially over that of 1975, and output of refined petroleum products increased owing to the addition of the new Zāwiyah refinery. Production in the cement industry almost doubled. Libya produced

[1] Economist, International Data and Analysis.
[2] Where necessary, values have been converted from Libyan pound-dinars (Lpd) to U.S. dollars at the rate of Lpd1 = US$3.38.

Table 1.—Libya: Production of mineral commodities

Commodity [1]		1974	1975	1976 [p]
NONMETALS				
Cement, hydraulic	thousand metric tons	[r] 485	830	1,500
Gypsum	do	[r e] 40	[r e] 50	60
Lime	do	20	14	325
Salt	do	10	10	[e] 10
MINERAL FUELS AND RELATED MATERIALS				
Gas, natural:				
Gross production	million cubic feet	425,363	489,035	633,754
Marketed [2]	do	345,199	382,633	505,527
Petroleum:				
Crude	thousand 42-gallon barrels	555,291	540,129	707,336
Refinery products:				
Gasoline	do	[r] 438	1,314	2,372
Kerosine and jet fuel	do	[r] 365	2,956	2,701
Distillate fuel oil	do	[r] 766	3,321	6,460
Residual fuel oil	do	[r] 1,204	5,548	6,935
Other	do	--	584	146
Refinery fuel and losses	do	[r] 220	1	147
Total	do	[r] 2,993	13,724	18,761

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the commodities listed, construction materials such as sand and gravel, crushed stone, brick, and tile are also produced, but available information is inadequate to make reliable estimates of output levels. Natural gas liquids are also produced, but are blended with crude oil and are reported as part of that total.

[2] Includes gas reinjected to reserves, if any.

small quantities of gypsum, lime, and other materials for use in the construction industry. Libya's production of mineral commodities in 1976 is given in table 1.

TRADE

Libya's mineral trade was dominated by crude oil and natural gas exports. Libya exported approximately 676 million barrels of crude in 1976, earning over $7 billion in foreign exchange. The United States replaced Italy, the United Kingdom, and West Germany as Libya's top oil market in 1976. An agreement was concluded with the U.S.S.R. for the export of nearly 15 million barrels of petroleum in 1977. During 1976, the Government proposed the nationalization of foreign trade and the establishment of a central Government agency to define import needs and to regulate supplies, although no final action was taken.

A major expansion program was to ease congestion at Libya's main ports. The Tripoli port was undergoing an increase in handling capacity to 12.5 million tons per year. A Japanese consortium led by Japan Industrial Development Co., Ltd., was engineering the second stage of construction which included new breakwaters, quay walls, container berths, and storage facilities. The capacity of the Benghazi port was to be increased from 1 million tons to 4.2 million tons per year by the year 2000. The Turkish firm Mudurgolu was contracted for the $83 million project to add 16 new berths as well as a new deepwater container berth. The Italian engineering firm Lodigiani signed a contract to build a $37.8 million harbor at Marsa el Brega. The Qaṣr Aḥmad harbor in Misurata was to undergo an expansion in port facilities to 500,000 tons per year, and the Derna port capacity was to be brought up to 400,000 tons per year.

Tonnage of the Libyan tanker fleet, operated by National Libyan Maritime Transport Co., was to be increased 50% by 1977 to 12 vessels from the present 8 totaling 686,500 tons. An additional tanker was on order for a later date.

Data on trade in 1975 were not available.

COMMODITY REVIEW

METALS

Aluminum.—Plans were finalized during the year by Libya and Yugoslavia for the establishment of an aluminum smelter in Libya that will use Yugoslav raw materials and Libyan natural gas. The $1.9 billion complex was to be completed in 1980 in northwestern Libya near the Tunisian border. Construction was to be by a Yugoslav consortium consisting of Energoinvest-Sarajevo, Titograd Aluminum Combine, Progresinvest of Belgrade, and Jadral of Obrovac. Yugoslavia was planning an expansion of its domestic bauxite operations and alumina refining capacity to supply the Libyan unit.

Iron and Steel.—Feasibility studies were in progress on the exploitation of iron ore deposits at Wadi Shati, situated nearly 600 kilometers from the coast near the town of Sebha. Reserves were estimated at nearly 2 billion tons of relatively low-grade ore. The three most promising areas were South Taroot, with 475 million tons averaging 50% iron; Askkeda, with 640 million tons averaging 51% iron; and Duésa, with 700 million tons averaging 45% iron. The construction of necessary infrastructure, particularly a railroad link with the coast, would be a major cost factor of the project.

At yearend 1975, Société Nationale de Sidérurgie (SNS) signed a $12.7 million contract with the Indian engineering firm, Dastur International, to provide consultative services for the execution of the first stage of an integrated iron and steel complex at Misurata, 200 kilometers east of Tripoli. The first stage of the plant was scheduled for completion in 1980 at an initial capacity of 1 million tons per year. The second stage, planned for 1986, would include a 5-million-ton-per-year blast furnace to process ore from reserves at Wadi Shati. The U.S.S.R. was to construct a pipeline to supply natural gas to the Misurata complex.

A ministeelworks was also under construction at Tripoli. In April 1976, a scrap iron smelting plant was inaugurated. The $8 million plant financed by Yugoslavia was to produce 20,000 tons per year of reinforcing bars. In July 1976, a longitudinal welding pipe factory was commissioned at the same location. The 22,000-ton-per-year plant was constructed by a Spanish firm.

NONMETALS

Cement.—Libya planned a major increase in cement production capacity to meet rising domestic demand. Cement production in 1976 totaled 1.5 million tons from two plants—the National Cement Co. plant near Homs with an annual capacity of 500,000 tons and the Libyan Cement Co. plant at Benghazi with an annual capacity of 1 million tons.

Five additional cement plants were in various stages of planning or construction. Compagnie Générale des Ciments de Sūk el Khamīs was established during 1976 to operate the new $114 million plant at Sūk el Khamīs, located south of Tripoli in the Tripolitania Region. The 1-million-ton-per-year plant, constructed by the West German firm Humboldt Mining Co., was scheduled to open in mid-1977. Humboldt and Welfenger (West Germany) were awarded a $110 million contract for the construction of a second cement plant at Benghazi to be opened in 1978. The contract for the Benghazi plant, which would have a capacity of 1 million tons per year, also provided for technical assistance in operating the plant for a 2-year period and training of Libyan personnel. National Cement Co. awarded the French firm Fives Cail Babcock S.A. a $150 million contract for construction of a 1-million-ton-per-year plant at Homs, due for completion in 1979. A fourth cement plant under construction at al Hawaari, located in southeastern Libya near al Jawf, was to have a 1-million-ton-per-year capacity. A smaller cement plant with a capacity of 500,000 tons per year was planned for Sebha in the central part of the country.

Also under construction in 1976 were a 60,000-ton-per-year brick factory at Benghazi, to be opened in 1977; a 200,000-ton-per-year brick factory at Tripoli, to be opened in 1978; and a 10,000-ton-per-year tile plant at Tripoli.

Fertilizer Materials.—In furtherance of its plans to develop a domestic fertilizer industry, Libya contracted British Sulphur Corp. Ltd. to conduct feasibility studies on establishing facilities for production of

phosphatic and ammonia fertilizers. Previous surveys confirmed the existence of commercial phosphate deposits in southwestern Libya at Jabal al Gharbī, al Ḥamādah al Ḥamrā', Masra, and Mrada.

Construction continued on the 1,000-ton-per-day ammonia plant at Marsa el Brega on the Mediterranean coast. Friedrich Uhde GmbH (West Germany) was the main contractor for the plant, scheduled for startup in 1977. During the year, Coppas International (U.K.) Ltd. received a $14 million contract for operation and maintenance of the plant and training of Libyan personnel.

In 1976, Foster Wheeler Italiana was awarded a $100 million contract for the installation of a urea plant at Marsa el Brega. The contract also provided for project offsites, including steam generation, power production, and desalination facilities, as well as basic designs for a town complex to be located in the area. Upon completion in 1979, the plant was expected to make Libya self-sufficient in ammonia-based fertilizer.

Gypsum.—Libya produced approximately 60,000 tons of gypsum in 1976 for use in cement manufacture. The two major quarries were located at the Jefren gypsum-anhydrite deposit south of Tripoli and the er-Régima deposit east of Benghazi.

Lime.—Lime production totaled 325,000 tons in 1976 from deposits near Tripoli and Benghazi. The Tripoli lime plant was supplemented by a new facility at Benghazi that started production in 1975 with an annual capacity of 37,500 tons of slaked lime. In addition, a new lime plant at Sūk el Khamīs was opened in June 1976. Annual production capacity was 70,000 tons of quick lime and 100,000 tons of slaked lime.

Salt.—The Libyan Government operated several small salt plants capable of producing about 10,000 tons per year of salt from seawater. During the year, a West German firm continued construction of a new salt plant at Tripoli, scheduled to produce 22,000 cubic meters of salt per day. Société Internationale de Dessalement de l'Eau de Mer (SIDEM) was contracted to build another salt factory at Tobruk. The plant was to be commissioned in 1977 with a capacity of 24,000 cubic meters per day.

Raw materials available in Libya's seawater and the large salt beds around Abū Kammāsh were to provide the basis for a large chemical complex that will begin production in 1980. A $514 million contract was awarded in 1976 to a West German consortium led by Salzgitter Industriebau GmbH. Other participants were Friedrich Uhde GmbH for plant installation, Philipp Holzmann A.G. for civil engineering, Klöckner Industrieanlagen GmbH for equipment, and Industriet-Montage (Indumont) for electrical engineering. The complex was to include four independent chemical units, a water desalination and power plant, and a separate tanker terminal. Annual production was to consist of 120,000 tons of salt, 50,000 tons of caustic soda, 60,000 tons of polyvinyl chloride, 8,000 tons of hydrochloric acid, 7,000 tons of sodium hydrochloride, and 5,000 tons of liquid chlorine.

MINERAL FUELS

Natural Gas.—Libya's natural gas production in 1976 was 634 billion cubic feet, 20% of which was flared. Reserves were estimated at 28,500 billion cubic feet at yearend 1976.

Esso Standard Libya Inc.'s liquefied natural gas (LNG) plant at Marsa el Brega was back in full production after the shutdown in late 1974 owing to a price dispute with its Italian and Spanish customers. The plant achieved record highs in average production in 1976 of 297 million cubic feet per day of LNG and 21,000 barrels per day of naphtha. The Nasser Field was the main source of associated gas production, supplying 345 million cubic feet daily. Esso Standard initiated a major project to develop the Hatéiba gasfield some 80 kilometers south of Marsa el Brega, with completion scheduled for yearend 1977.

Occidental of Libya, Inc. (Oxylibya) produced approximately 2 million barrels of gas liquids—naphtha, butane, and propane—at its liquefied petroleum gas (LPG) plant in 1976.

Petroleum.—*Exploration.*—Exploration activity increased in Libya in recent years owing to the conclusion of a number of production-sharing agreements with foreign companies. During 1976, nearly 455,000 square kilometers of territory was

held under contract by 20 companies. The agreements provided for the foreign companies to assume all exploration risk costs, giving the Government about $600 million in exploration commitments. In the event of a commercial discovery, the Government was to receive between 81% and 85% of production. Libya was to pay the majority of development costs but would be reimbursed with interest over the long term if production reached a certain undisclosed amount. The major exploration agreements are outlined in table 2.

Oxylibya, which held exploration blocks covering 45,000 square kilometers, had three discoveries in the past year. In the northwestern Sirte Basin, two wells tested 882 barrels and 2,045 barrels per day, respectively, from about 3,900 feet. Development drilling began immediately and Oxylibya scheduled one of the fields for production in 1977. Negotiations were underway with Oasis Oil Co. of Libya, Inc., to conclude a throughput arrangement with the Oasis pipeline to es-Sider. A third discovery, 113 kilometers southwest of es-Sider, tested 2,400 barrels per day of 52.5° API gravity crude.

A consortium led by Elf-Aquitaine, which held both onshore and offshore tracts, reported a large oil discovery about 100 kilometers north of Zurara near the Tunisian border. Further drilling to delineate reserves was undertaken. Shares in the consortium were divided among Elf-Aquitaine (50%), Elf Libye (25%), Österreichische Mineralölverwaltung A.G. (OMV) of Austria (15%), and Wintershall A.G. of West Germany (10%).

A well drilled by NOC during 1976 tested 4,000 barrels per day at 6,000 feet. The discovery was in the al Ḥamādah al Ḥamrā' region of western Libya, where the company has been drilling for more than 2 years. Umm al-Gawabi Co., a wholly-owned subsidiary of NOC, struck an estimated 100-million-barrel deposit near Beda Field and another deposit of an estimated 50 million barrels near Nafoora Field. Commercial production from both fields was planned for 1977.

Total conducted a 10,000-square-kilometer aeromagnetic survey of its Mizrāq concession area in southwestern Libya. Exxon completed seismic surveys on 10,000 square kilometers in the Mediterranean offshore and onshore area. Exxon was to begin drilling offshore in early 1977. Mobil Oil Libya Ltd. surrendered the offshore portion of its acreage in 1976 but was to be assigned additional areas onshore.

The dispute between Libya and Tunisia continued in 1976 over rights to explore for oil in an area of the Mediterranean bordering both nations. During the year, the two countries agreed to submit the case to the International Court of Justice at The Hague for settlement.

Table 2.—Libya: Exploration concessions in 1976

Company	Location	Date of agreement	Acreage (square kilometers)	Exploration commitments		Production sharing [1] (percent)
				Value (millions)	Years	
Oxylibya	Sirte Basin onshore	1974	45,000	$90	5	81–19
Elf-Aquitaine	Sirte Basin onshore	1974	20,000	45	4	85–15
	Zuara offshore					81–19
Exxon	Sirte Basin onshore	1974	14,000	90	5	85–15
	Zuara offshore					81–19
PETROBRAS [2]	Sirte Basin onshore	1974	20,000	40	5	85–15
	Mizrāq Basin onshore					85–15
Mobil	Sirte Basin onshore	1974	4,800	70	5	85–15
Agip	Sirte Basin, Kufra, Cyrenaica onshore	1974	144,000	82	5	85–15
	Zuara offshore					81–19
Total	Mizrāq Basin onshore	1974	39,000	90	5	85–15
	Cyrenaica offshore					81–19
CFP [3]	Mizrāq Basin onshore	1974	50,000	90	5	85–15
	Cyrenaica offshore					81–19

[1] Percentage of production sharing between the Government (first figure) and foreign company (second figure).
[2] Petróleo Brasileiro S/A.
[3] Compagnie Française des Pétroles.

Production.—Following the phenomenal growth between 1961 and 1970, oil production in Libya started to decline owing to a conservation policy instituted by the Government. In 1976, however, the Government urged production increases and output reached 1.9 million barrels per day, compared with 1.5 million barrels per day in 1975. Libya planned to attain the 2.4-million-barrel-per-day mark by 1977. At yearend 1976, Libya's crude oil reserves were estimated at 25.5 billion barrels.

As a result of the participation and nationalization measures initiated in 1973, Libya acquired ownership of over two-thirds of its oil production. The Government held a majority interest in all but two of the eight foreign operating companies (see table 3). The companies accepted compensation based on the net book value of their assets and the right to buy back 51% of their former production. During 1976, Libya raised the price of light crude from $12.13 to $12.62 per barrel in accordance with a decision by the Organization of Petroleum Exporting Countries (OPEC) to allow members to adjust their rates to suit market conditions.

The greatest potential for production increase was that of the two subsidiaries of the State-owned NOC—Arabian Gulf Exploration Co. (AGECO) and Umm al-Gawabi. AGECO, created in 1971 to assume the interests of BP Exploration Company (Libya) Ltd. and Nelson Bunker Hunt, operated the Sarīr Field, which averaged 270,000 barrels per day in 1976. Production capacity at Sarīr, Libya's largest field, was about 400,000 barrels per day, to be increased to 600,000 barrels per day by 1980. Umm al-Gawabi was formed in 1974 to take over the interests of American Overseas Petroleum Ltd. (Amoseas), a joint venture of Texaco Inc. and Standard Oil Co. of California. In 1976, the International Court of Justice ruled that this nationalization was illegal and ordered the Libyan Government to pay just compensation by June 30, 1977. Umm al-Gawabi produced approximately 110,000 barrels per day from several fields.

Oasis, which included Continental Oil Company of Libya (Conoco), Marathon Petroleum Libya Ltd., and Amerada Hess Corp., was the country's largest producer with an average of nearly 700,000 barrels per day in 1976. Oxylibya averaged 350,000 barrels per day from eight fields. Agip, a subsidiary of Italy's State-owned Ente Nazionale Idrocarburi (ENI), produced 147,000 barrels per day from its single Abu Tiffel Field. Esso Sirte, a collaboration of Esso and Grace Petroleum Corp., produced 65,000 barrels per day at its Raguba Field. The Nasser, Jabal, and Ralah Fields, operated by Esso Standard, produced at a combined rate of 190,000 barrels per day, with the Nasser Field contributing 88% of the total. Libya's oil production in 1976 is detailed in table 4.

Table 3.—Libya: Production concessions in 1976

Group	Concession holders	Percentage of holdings
NOC	NOC	100
AGECO	----do	100
Umm al-Gawabi	----do	100
Esso Standard	----do	51
	Esso Co	49
Esso Sirte	NOC	63.5
	Esso Co	24.5
	Grace Petroleum Co	12.0
Oasis	NOC	59.2
	Conoco	16.3
	Marathon Oil Co	16.3
	Amerada Hess Corp	8.2
Mobil	NOC	51
	Mobil Oil Corp	31.85
	Gelsenberg A.G	17.15
Oxylibya	NOC	51
	Occidental Petroleum Corp	49
SNPA [1]	Hispanoil	42
	Aquitaine Libye	28
	Murphy Oil Corp	16
	Elf Libye	14
Agip S.p.A. Filliale Libia	NOC	50
	Agip	50
Amoco Libya Oil Co	Amoco	100

[1] Société Nationale des Pétroles d'Aquitaine.

Table 4.—Libya: Oilfields in 1976

Company	Oilfield	Discovery date	Average rate of production (thousand barrels per day)
Oasis	Gialo	1961	226
	Defa	1969	172
	Waha	1960	112
	Bahi	1968	79
	Dahra	1959	31
	Samah	1961	29
	Belhedan	1962	7
	Zaggut	1962	3
Oxylibya	Intişār D	1967	177
	Intişār A,B,C,E,L	1967	96
	Augila and Nafoora	1965	79
AGECO	Sarir	1961	270
Esso Standard	Nasser	1959	167
	Jabal	1962	21
	Ralah	1964	1
Umm al-Gawabi	Kotla	1963	110
	Bū al 'Awn	1972	
	Beda	1959	
	Dor	1967	
Agip	Abu Tiffel	1968	147
Mobil	Amal	1959	64
	Ora	1962	9
	Hofra	1958	2
Esso Sirte	Raguba	1961	65
Aquitaine Libye	Majid	1968	13
	Meheiriga	1974	12
Amoco	Sahābī	1961	6

Refining.—Libya had a total crude oil processing capacity of about 78,800 barrels per day, distributed among the following refineries:

Refinery	Operator	Capacity (barrels per day)
Zāwiyah	NOC	60,000
Nafoora	Amoseas	1,800
Marsa el Brega	Esso Standard	8,000
Amal	Mobil	1,800
Intiṣār	NOC	1,800
Zuetina	do	3,000
Dahra	Oasis	2,400

In an effort to raise refining capacity above 1 million barrels per day, several projects were initiated. The Zāwiyah refinery, the country's largest, was to double its capacity in 1977. SNAM Progetti S.p.A. (Italy) was awarded a $53 million contract to expand the refinery, situated 45 kilometers west of Tripoli. In December 1976, the Dutch firm Protech International B.V. was contracted to construct a 370-kilometer pipeline from the Hamada region to the Zāwiyah refinery.

SNAM Progetti was also charged with studies for and supervision of construction of a 220,000-barrel-per-day refinery at Tobruk. The actual construction of the $338 million refinery, scheduled for completion in 1978, was to be by Italy's Foster Wheeler Italiana. Plans for three other refineries were also announced: A 300,000-barrel-per-day refinery at Marsa el Brega; a 400,000-barrel-per-day refinery at Zuetina, located 125 kilometers south of Benghazi; and a 220,000-barrel-per-day refinery at Misurata, located east of Tripoli.

The methanol unit at the large petrochemical complex under construction at Marsa el Brega was to be commissioned in early 1977. Constructed by Friedrich Uhde GmbH, the $88 million plant was to have a capacity of 1,000 tons of methanol per day. The plant was to be under the supervision of National Methanol Co., equally owned by NOC and Oxylibya. A unit for the production of 1,000 tons of ethylene per day was to be completed in 1978. The $203 million ethylene plant was under construction by Stone & Webster Engineering Ltd. (United Kingdom).

The Mineral Industry of Madagascar

By David E. Morse [1]

One of the outstanding features of Madagascar is its varied mineralization fairly well distributed throughout the country. The island contains large resources of chromite, iron ore, lateritic nickel, limestone, mica, quartz, and zircon. The primary minerals produced in 1976 were chromite, graphite, and phlogopite mica. Chromite production increased 14% over that of 1975 to 221,000 tons; graphite output declined 362 tons to 17,412 tons; and mica production decreased from 544 tons in 1975 to 81 tons in 1976. Madagascar's small-scale mines produced a wide variety of semiprecious and ornamental stones, including agate, beryl, celestite, jasper, rhodenite, rose and smoky quartz, opal, tourmaline, and zircon. The mineral sector of the economy continued to be a small contributor to the gross domestic product (GDP) but a significant source of foreign exchange during 1976. No petroleum exploration activity was conducted in Madagascar during the year although Total Chimie of France and Agip S.p.A. of Italy maintained concessions for areas along the west coast.

The Democratic Republic of Madagascar came into being on December 30, 1975. The island nation had been called the Malagasy Republic since its independence in 1960.

In keeping with its expressed goal of State ownership of all basic means of production, the Government nationalized the petroleum sector of the economy in July. The companies most affected were the joint shareholders of the country's only petroleum refinery. The State had previously held a 51% share in the refinery, and Total Petroleum Ltd., Esso Co., Caltex Petroleum Corp., and Shell Oil Co. had controlled the remaining 49%. The State assumed full control of importing, refining, storing, and marketing petroleum and petroleum products.

The Government stated that it would require 51% or greater ownership in any new mining venture and that the majority of the profits should be kept in the country to minimize the loss of foreign exchange and to aid development.

Initial site preparations began during the year on the Namorona River hydroelectric complex. The bulk of the electricity produced was to go to planned aluminum smelters. The planned $100 million Rogez hydroelectric complex on the Vohitra River in east-central Madagascar neared construction. The output of the Rogez project was to be used to exploit the Ambotavy nickel deposit and to power a planned ferrochrome plant.

The Government continued its efforts to improve the island's road system. Work began on improvements to the central-south axis road and the Arivonimamo-to-Analavory link. The construction of a 370-kilometer vehicle track between Tsiroanomandidy and Maintirano was funded by an Arab Development Bank loan. Most mineral exports were carried by rail from Antananarivo (formerly Tananarive) to the port of Tamatave for transport to world markets.

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[1] Physical scientist, International Data and Analysis.

PRODUCTION AND TRADE

Production data is shown in table 1.

The value of mineral exports in 1976 was $29.0 million,[2] a 58% increase over the $18.4 million in 1975. Exports of chromite concentrate of 218,000 tons were valued at $22.4 million, a per-ton increase of 26%, reflecting higher world chromite prices. Compared with those of 1975, graphite exports in 1976 increased 5% to 17,900 tons and increased 20% in value to about $5.3 million. Phlogopite mica exports rebounded to 930 tons in 1976 from 137 tons in 1975 and were valued at $750,000. The export value of gem, semiprecious, and ornamental stones was almost triple that of 1975 at nearly $550,000. In 1976, crude oil imports were about 4.1 million barrels, a 29% decrease from those of 1975.

Because of the Government's tight control on imports and the increased value of agricultural exports, Madagascar almost achieved parity between imports and exports in 1976, compared with the 1975 deficit of $36.5 million.

[2] Where necessary, values have been converted from Malagasy francs (FMG) to U.S. dollars at the rate of FMG241 = US$1.00.

Table 1.—Madagascar: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Beryllium, beryl concentrate, industrial grade, gross weight	13	15	17
Chromium, chromite concentrate, gross weight	155,874	194,127	221,172
Gold, mine output, metal content—troy ounces	77	158	160
NONMETALS			
Abrasives, natural, garnet (industrial only)—kilograms	2,800	1,751	4,281
Cement, hydraulic	61,447	58,021	74,000
Clays, kaolin	3,505	4,307	25,397
Feldspar	1	1	--
Gem and ornamental stones:			
Agate—kilograms	60,200	134,400	133,806
Amazonite—do	6,800	2,300	2,103
Amethyst:			
Gem—do	9,100	3,100	--
Geodes—do			1,475
Apatite (ornamental only)—do	715	992	5
Aragonite	648	83	121
Beryl—kilograms	2	5	3
Calcite (ornamental only)	6	317	2
Celestine—kilograms	41,100	39,700	32,462
Chalcedony—do	196	--	--
Cipoline marble	[2] 545	35	29,700
Citrine, gem—kilograms	20	147	18
Garnet:			
Gem—do	16	9	6
Other—do	6,300	--	1,876
Jaspar—do	34,300	11,600	1,730
Labradorite—do	8,400	10,400	7,646
Opal—do	500	4,900	--
Quartz:			
Rose quartz—do	300,800	42,700	92,450
Geodes—do	2,400	85	600
Other ornamental—do	3,400	1,000	1,516
Rhodenite—do	28,100	12,400	3,335
Tourmaline:			
Gem—do	([3])	([3])	--
Other ornamental—do	1,200	2,200	68,000
Graphite, all grades	17,280	17,774	17,412
Mica, phlogopite:			
Block	151	99	7
Splittings	551	445	62
Scrap	155	--	12
Total	857	544	81
Quartz, piezoelectric—kilograms	368	254	89
Salt, marine	e 20,000	26,247	e 27,000
Stone:			
Calcite, industrial	1,449	--	3,215
Quartz, metallurgical	105	--	107
Other nonmetallic minerals: Bastnaesite—kilograms	--	--	10
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	1,148	1,154	920
Kerosine and jet fuel—do	600	689	482
Distillate fuel oil—do	1,306	1,422	1,160
Residual fuel oil—do	1,459	1,962	554
Other—do	116	105	81
Refinery fuel and losses—do	251	299	1,123
Total—do	4,880	5,631	4,320

e Estimate. p Preliminary.

[1] In addition to the commodities listed, modest quantities of crude construction materials (including clays, stone, sand, and gravel) presumably were produced, but output is not reported and available information is inadequate to formulate reliable estimates of output levels.

[2] Reported as marble, without the qualifying term cipoline.

[3] Less than ½ unit.

Table 2.—Madagascar: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, all forms	3	(1)
Chromite	180,320	85,498
Copper metal including alloys:		
Unwrought and scrap	188	66
Semimanufactures	(1)	(1)
Iron and steel metal:		
Scrap	9,714	--
Semimanufactures	220	9
Lead:		
Oxide	197	76
Metal including alloys, all forms	4	--
Thorium ore and concentrate	--	169
Titanium ore and concentrate	16	7
Zinc metal including alloys, all forms	15	13
Other ores and concentrates	2	2
NONMETALS		
Abrasives, natural	3	9
Cement, hydraulic	2	--
Clays and clay products:		
Crude clays, n.e.s	--	9
Products	1	(1)
Fertilizer, natural and manufactured	--	1
Graphite, natural	17,451	17,021
Mica:		
Crude, including splittings and waste	1,871	1,315
Worked, including agglomerated splittings	5	3
Precious and semiprecious stones (except diamond), including quartz crystal and synthetic stones, kilograms	237,745	420,724
Salt and brine	3,078	1,967
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	27	15
Worked	31	3
Quartz	135	40
Sand, excluding metal bearing	(1)	--
Sulfur, sulfuric acid	(1)	--
Other crude nonmetals, n.e.s	4	27
MINERAL FUELS AND RELATED MATERIALS		
Coal and briquets	1	--
Petroleum refinery products:		
Gasoline, thousand 42-gallon barrels	360	502
Kerosine, do	279	286
Distillate fuel oil, do	440	--
Residual fuel oil, do	1,096	--
Lubricants, do	2	--
Other:		
Liquefied petroleum gas, do	55	--
Bitumen and bituminous mixtures, do	(1)	--
Unspecified, do	41	1
Total, do	2,273	789

[1] Less than ½ unit.

Table 3.—Madagascar: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Oxides and hydroxides	78	181
Metal including alloys, all forms	813	876
Chromium oxide and hydroxide	2	3
Cobalt oxide and hydroxide	(1)	--
Copper:		
Ore and concentrate	(1)	(1)
Metal including alloys, all forms	37	91
Gold metal, unworked and partly worked ---troy ounces--	3,633	18,486
Iron and steel:		
Scrap	19	(1)
Pig iron, ferroalloys, similar materials	15	20
Semimanufactures	44,074	41,298
Lead:		
Oxides	21	17
Metal including alloys, all forms	408	405
Magnesium metal including alloys, all forms	(1)	(1)
Manganese oxides	(1)	(1)
Mercury ---76-pound flasks--	3	2
Nickel metal including alloys, all forms	(1)	(1)
Platinum-group metals including alloys, all forms ---troy ounces--	32	96
Rare-earth metals including alloys, all forms	2	1
Silver metal including alloys, all forms ---troy ounces--	5,980	4,726
Tin metal including alloys, all forms	8	20
Titanium oxides	9	24
Zinc:		
Oxide and hydroxide	3	22
Metal including alloys, all forms	19	164
Zirconium ore and concentrate	--	1
Other:		
Oxides and hydroxides	7	124
Metals including alloys, all forms:		
Metalloids	2	5
Pyrophoric alloys	2	3
Base metals including alloys, all forms, n.e.s	14	6
NONMETALS		
Abrasives:		
Crude, natural	16	6
Fused alumina (artificial corundum)	5	2
Dust and powder of precious and semiprecious stones ---kilograms--	335	58
Grinding and polishing wheels and stones	42	62
Asbestos	5	10
Barite	(1)	93
Boron materials:		
Crude natural borates	40	131
Oxide and acid	30	66
Cement, hydraulic	26,891	50,986
Chalk	239	120
Clays and clay products (including all refractory brick):		
Crude clays, n.e.s	350	1,291
Products:		
Refractory (including nonclay bricks)	293	303
Nonrefractory	251	549
Diamond, all grades ---thousand carats--	20	160
Diatomaceous earth	14	15
Fertilizer materials:		
Crude and manufactured:		
Nitrogenous	4,737	4,256
Phosphatic	855	331
Potassic	4,462	6,687
Other, including mixed	2,856	1,339
Ammonia	34	24
Graphite, natural	1	(1)
Gypsum and plasters	3,225	5,298
Lime	2,140	2,546
Magnesite	37	1
Mica, crude and worked	2	4
Pigments, mineral:		
Natural, crude	57	33
Iron oxides, processed	28	31
Precious and semiprecious stones (except diamond), including synthetic ---kilograms--	(1)	4
Salt and brine	156	108
Sodium and potassium compounds	3,166	2,723

See footnote at end of table.

Table 3.—Madagascar: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone, crude and worked		6	--
Gravel and crushed rock, n.e.s		8	1
Quartz and quartzite		(1)	(1)
Sand, excluding metal bearing		3	13
Sulfur:			
Elemental, all forms		3	6
Sulfur dioxide		2	3
Sulfuric acid, oleum		157	151
Talc, steatite, soapstone, pyrophyllite		17	59
Other:			
Crude		70	453
Oxides and hydroxides of magnesium, strontium, barium		5	369
Bromine, iodine, fluorine		(1)	(1)
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		--	(1)
Carbon black		6	4
Coal including briquets, all grades		13,734	19,623
Coke and semicoke		53	119
Hydrogen, helium, rare gases		8	3
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	4,537	5,824
Refinery products:			
Gasoline	do	29	31
Kerosine and jet fuel	do	5	(1)
Distillate fuel oil	do	60	2
Residual fuel oil	do	27	4
Lubricants	do	32	20
Other:			
Liquefied petroleum gas	do	(1)	(1)
Mineral jelly and wax	do	26	23
Pitch and pitch coke	do	(1)	(1)
Petroleum coke	do	1	--
Bitumen, bituminous mixtures, other residues	do	53	25
Unspecified	do	2	54
Total	do	235	159
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		144	49

[1] Less than ½ unit.

COMMODITY REVIEW

METALS

Bauxite.—A French consortium was to develop the 165-million-ton Manantenina bauxite deposit. Planned output was 5 million tons per year. Neither the timetable for mine development nor the status of the proposed aluminum smelter was known. The smelter was to use power from the hydroelectric complex under construction on the Namorona River.

Chromite.—Madagascar Chrome Resources Development Co. conducted geologic surveys and diamond drilling on its 8,000-square-kilometer concession area between Andriamena and Tsaratanana northwest of Lake Alaotra. Mining operations were to begin in 1979 with most of the output to be exported to Japan.

Kraomita Malagasy, formerly Compagnie Minière d'Andriamena (Comina), operated the country's only chromite mines located at Andriamena and Befandriana Nord. Chromite output averaged over 17,000 tons per month of dry concentrate containing 50% to 52% Cr_2O_3 from Madagascar's Government-owned mines. Over 80% of the output came from the Andriamena mine that had reserves of about 5 million tons. A 40,000-ton-per-year ferrochrome plant was planned to come onstream in 1980 and use power from the Rogez hydroelectric complex.

Iron Ore.—Iron ore deposits have been studied at Ambotavy near Moramanga in east-central Madagascar, at Ambonimahavony near Ansirabe, at Soalala on the west coast south of Majunga, between Bekisopa and Fasentsara in south-central Madagascar, and in the Ambohipaky coastal region. The relatively low iron content and general lack of good surface

transportatiton have deterred development of the deposits.

Nickel.—A detailed study has been made of the 120-million-ton 1% to 2% lateritic nickel deposit at Ambotavy. It was to be exploited using power generated at the planned Rogez hydroelectric power project. No progress toward development of this deposit was reported during 1976.

Other Metals.—A pilot plant was operated by Montedison S.p.A. of Italy to extract ilmenite and zircon from the beachsands of the east coast near Tamatave. United States Steel Corp. and Bureau de Recherches Géologiques et Minières (BRGM) of France began pilot plant operations on beachsand deposits in the Fort-Dauphin area during 1976. These deposits along the southeast coast contained several million tons of ilmenite with lesser amounts of zircon and monazite.

NONMETALS

Cement.—The country's only cement plant at Amoania operated at full capacity during 1976. An accord was signed with the U.S.S.R. for the construction of a new cement plant in the Antananarivo area. Details of the agreement were not available.

Graphite.—Production of quality flake graphite in 1976 was nearly double the 1975 output. Total graphite production remained at about the same level it had been for the previous 2 years. World demand for graphite remained high but the island's principal operators were reluctant to make commitments to expand output because of the Government's recent (1975) nationalizatiton of other mining operations.

Mica.—Production of phlogopite mica from mines in southeastern Madagascar dropped to 81 tons in 1976, a decrease of 85% from that of 1975. Mica production has been affected by synthetic products in some electronic uses and by a low-cost substitute made in India from mica scrap. The quality of Madagascar's mica has been decreasing, and mica mining companies closed down industrial operations early in the year owing to lack of demand for blocks and splittings.[3] The 1976 exports of 936 tons consisted mostly of scrap coming from previous years' stockpiles.

MINERAL FUELS

Coal.—The Sakoa formation in southeastern Madagascar, 160 kilometers east of Tulear, contains over 60 million tons of bituminous coal with a 17% ash content. Total Sakoa resources were estimated to be nearly 1 billion tons of high-ash noncoking coal. Experimental mining operations were conducted at Andranomanintsy during the 1950's by the Bureau Minière de La France. Total coal output between 1950 and 1960 was 22,800 tons. Little activity has taken place since 1960 although Utah Development Co. has maintained a coal prospecting permit in the area since 1974. Significant infrastructure investment would be needed for development because of the remoteness of the deposits and lack of good transportation facilities.

Petroleum.—No petroleum exploration activity was conducted in Madagascar during 1976. The Government nationalized the country's oil companies in July 1976. The State assumed control of the only oil refinery and all storage, transport, and marketing facilities in a negotiated settlement. The petroleum refinery at Tamatave had an input of 4.32 million barrels during the year, a 24% decrease from that of 1975. The decrease was in response to the Government's policy of restricting imports to achieve balance between imports and exports.

[3] U.S. Embassy, Antananarivo, Madagascar. State Department Telegram 1337, July 21, 1977.

The Mineral Industry of Malaysia

By E. Chin [1]

The Malaysian gross national product (GNP) in 1976 was $10.8 billion [2] in current dollars compared with $8.7 billion in 1975. In terms of constant 1970 dollars, the GNP in 1976 was $7.6 billion, a real growth of 11.5% over that of 1975. The gross domestic product (GDP) in 1976 was $6.9 billion in 1970 dollars and was distributed by sector as follows, in million dollars: Agriculture, forestry, and fishing, 2,084; manufacturing, 1,037; wholesale and retail trade, 909; transport and communications, 475; mining and quarrying, 324; construction, 304; electricity and water, 176; and other, 1,551. The value of production by the mining and quarrying sector increased 27% over that of 1975. The increase in oil production offset the decline in quantity of bauxite and tin-in-concentrate produced in 1976. The capacity to produce crude oil averaged 165,400 barrels per day in 1976, an increase of 69% over the daily output in 1975.

Malaysia's proven reserves of oil were estimated at around 1 billion barrels. In regard to the status of its oil reserves, the Government was seeking an optimum balance between financing economic growth in light of higher oil revenues and conserving this depleting, nonrenewable resource. Petroleum Nasional Berhad (Petronas), the agency charged with coordinating the exportation of petroleum in the country, concluded the transfer of petroleum rights from the 13 State governments to the Federal Government. Also, since April 1975, foreign oil companies operating in Malaysia were under an interim arrangement in their oil exploration and production activities. Because of protracted negotiations on production-sharing arrangements, the Government gave notice on July 29, 1976, to the oil companies with exploration rights in Malaysia to conclude their agreements with Petronas by November 15, 1976.

Sarawak Shell Berhad and Sabah Shell Petroleum Co. Ltd., and their partner, Picten Malaysia Co., concluded production-sharing agreements with the Government on November 30, 1976, and Exxon Production Malaysia, Inc., on December 6, 1976. Provisions of the three agreements included the following: A maximum cost recovery by the oil companies equivalent to 20% of the oil and 25% of the gas produced as well as 10% royalty to the Government; a 70–30 after-cost-profit split before taxes of the remainder in favor of Petronas; payment of income taxes (45% on oil) by both contractor and Petronas; and a refund of 70% of profit oil proceeds when the price of oil exceeds the base price of $12.72 per barrel during the first year (the base price increases 5% each year). Petronas will receive a bonus for each commercial discovery and a production bonus from each contractor whose average quarterly production exceeds 725,000 kiloliters. The agreements were for a period of 20 years effective April 1, 1975. Provisions for various extensions to be granted on application include: Exploration period of 3 years plus 2 years' extension on application; 2 years for development with an extension to 4 years; and production life of 15 years for oil and gas which can be extended to 20 years in the case of gas.

Production of tin-in-concentrate in Malaysia has declined during 1973–76 at

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Malaysian dollars (M$) to U.S. dollars at the rate of M$2.50=US$1.00.

an average rate of 4.5% per year. Moreover, the domestic tin industry claimed it was assessed a heavier tax burden (export duty and surcharge, tin profits tax, and income tax), which caused a higher cost for production. The Malaysian Chamber of Mines estimated that 70% of the gross profits from the sales of tin was consumed by various taxes imposed by the Government and that about 30% of the total tax on tin was for export duty and surcharge alone.

To encourage investment in the industry, the Government was reviewing the tax structure of the tin industry. Reduced duties on import items required by tin operators in Malaysia, such as diesel engines and water pumps, were being considered. The Government was also proposing to introduce a new national mining code that would standardize and streamline procedures governing prospecting, alienation, issue and renewal of leases, conversion, and other provisions to stimulate production. The floor price for tin under the International Tin Agreement is regarded as a minimum guaranteed price. At the beginning of 1976, the floor price for tin was M$900 per picul; three price increases during the year brought the yearend price to M$1,075 per picul. The International Tin Council then revised the floor price under the Fifth International Tin Agreement to M$1,200 per picul, effective July 15, 1977. It was believed that the higher floor price would be an inducement for tin producers to increase output. However, the administrative and fiscal problems facing the tin industry in Malaysia continued to inhibit increased investment by miners.

The Government was attempting to establish a tin exchange in Kuala Lumpur, which would be part of a program to set up a multicommodity exchange to deal with exports of the country's major primary commodities such as rubber, tin, and palm oil. The Ministry of Primary Industries was conducting a study on the practicability and feasibility of developing Kuala Lumpur as a terminal market. Assistance was being sought to engage consultants to undertake a feasibility study and prepare a report.

PRODUCTION

Crude petroleum became Malaysia's largest mineral foreign exchange earner. During the year, total production of crude oil was 60.5 million 42-gallon barrels, all from eight fields in East Malaysia. At yearend, production rates per day for the three operating companies were as follows, in barrels: Exxon, 11,336; Sabah Shell, 64,305; and Sarawak Shell, 116,213. The bulk of the production of crude oil is exported; only about 20% is consumed locally by three refineries.

Production of tin-in-concentrate was 63,401 tons; output by dredging and gravel pumping operations accounted for about 86% of the total output. Production of tin metal by three local smelters totaled 78,018 tons. Columbite, gold, scheelite, ilmenite, monazite, xenotime, and zircon were produced as byproducts of tin mining operations. Output of bauxite and iron ore continued to decline owing to the lower tenor of ore and gradual depletion of deposits as well as reduced demand by foreign markets.

Table 1.—Malaysia: Production of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity [2]	1974	1975	1976 [p]
METALS			
Aluminum, bauxite, gross weight ---thousand tons	948	704	660
Antimony, mine output, metal content (Sarawak)	[r] 245	250	250
Columbium and tantalum concentrates, gross weight	[r] 93	50	46
Copper, mine output, metal content [e 3]	[r] 200	[r] 5,300	20,000
Gold, mine output, metal content:			
West Malaysia ---troy ounces	3,435	2,484	3,574
Sarawak ---do	1,004	1,192	964
Total ---do	4,439	3,676	4,538
Iron and steel:			
Iron ore and concentrate ---thousand tons	481	348	308
Pig iron and ferroalloys [e] ---do	[r] 170	[r] 180	190
Crude steel [e] ---do	[r] 183	[r] 195	200
Manganese ore and concentrate, gross weight	85,262	133,308	94,112
Rare-earth metals: [4]			
Monazite, gross weight	1,783	3,285	1,879
Xenotime (yttrium mineral), gross weight	102	53	139
Tin:			
Mine output, metal content	68,124	66,395	63,401
Smelter output [5]	84,396	83,068	78,018
Titanium: Ilmenite concentrate, gross weight [4]	153,530	112,248	180,004
Tungsten, mine output, metal content	131	106	64
Zirconium: Zircon concentrate, gross weight [4]	2,753	10,357	3,129
NONMETALS			
Barite	[e] 800	814	6,096
Cement, hydraulic ---thousand tons	1,364	1,446	1,739
Clays, kaolin	146,374	16,795	26,254
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural (Sarawak):			
Gross production [e] ---million cubic feet	31,000	38,000	45,000
Marketed production ---do	[e] 2,800	3,137	[e] 3,700
Petroleum: [6]			
Crude ---thousand 42-gallon barrels	29,537	35,774	60,547
Refinery products:			
Gasoline ---do	4,052	3,942	6,210
Jet fuel ---do	657	1,055	1,550
Kerosine ---do	2,153	1,938	2,050
Distillate fuel oil ---do	6,351	6,169	8,900
Residual fuel oil ---do	9,929	10,039	10,560
Other ---do	8,724	4,965	4,760
Refinery fuel and losses ---do	1,495	948	510
Total ---do	33,361	29,056	34,540

[e] Estimate. [p] Preliminary. [r] Revised.

[1] All production is from West Malaysia unless otherwise indicated.

[2] In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone), salt, and fertilizer are produced, but production is not reported and available information is inadequate for the formulation of reliable estimates of output levels.

[3] Estimates based on exports of copper concentrates.

[4] Based on export figures. May differ from data shown elsewhere in this chapter because of difference in source.

[5] Includes small production of tin from a smelter in Singapore.

[6] Includes production from Sarawak and West Malaysia.

TRADE

Total trade value in 1976 was estimated at $9.3 billion; exports were valued at $5.4 billion and imports at $3.9 billion. By standard industrial trade classification, Malaysia was a net importer of food, beverages, and tobacco, and machinery and transport equipment; it was a net exporter of inedible crude materials, mineral fuels, animal and vegetable oils and fats, chemicals, and manufactured goods and articles.

By value, Malaysia's export markets in 1976 were as follows, in billion dollars: Western Europe, 1.2; Association of Southeast Asian Nations (ASEAN), 1.2 (Singapore alone, 1.0); Japan, 1.1; the United States, 0.8; and other, 1.1. Imports were from Japan, the United States, Singapore,

the United Kingdom, Australia, the People's Republic of China, and others, in that order. Malaysia's leading export commodity was rubber (valued at $1,247 million), followed by timber materials ($930 million), crude petroleum ($620 million), and tin and tin-in-concentrates ($611 million). Exports of other mineral-related materials included partly-refined and refined petroleum products ($207 million), chemicals and chemical products ($28 million), nonmetallic mineral products ($28 million), and manufactures of iron and steel ($25 million).

Malaysia currently supplies about one-fourth of the world's production of tin. Excluding petroleum, tin accounts for about 90% of the value of all Malaysian mineral exports. The United States, Japan, and the European Economic Community were the major markets for Malaysian tin, consuming collectively about 80% of total Malaysian tin exports. Most of the remainder of Malaysia's mineral exports were bauxite, iron ore, ilmenite, and copper concentrate. The bulk of these exports was to Japan.

Table 2.—Malaysia: Exports and reexports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite	814,956	649,373
Alumina	(2)	21
Metal including alloys:		
Scrap	868	904
Unwrought	31	18
Semimanufactures	1,201	727
Columbite ore	735	83
Copper:		
Ore	--	13,278
Metal:		
Scrap	1,717	2,351
Unwrought and semimanufactures	635	651
Iron and steel:		
Iron ore, thousand tons	176	94
Metal:		
Scrap	7,007	3,660
Pig iron, ferroalloys, similar materials	130	86
Steel, primary forms	710	388
Semimanufactures:		
Bars, rods, angles, shapes, sections	32,245	4,113
Universals, plates, sheets	28,832	2,294
Hoop and strip	1,628	424
Rails and accessories	1,941	103
Wire	6,226	489
Tubes, pipes, fittings	16,333	6,151
Castings and forgings, rough	1,120	754
Lead:		
Oxide	58	102
Metal including alloys, all forms	235	289
Magnesium metal including alloys, all forms	(2)	1
Manganese ore	107,663	108,351
Mercury, 76-pound flasks	5	9
Nickel metal including alloys, all forms	188	21
Platinum-group metals and silver:		
Platinum-group, troy ounces	--	15
Silver, do	44	2,392
Rare-earth metals, monazite	1,724	(2)
Thorium ore	103	3,338
Tin metal including alloys:		
Scrap	50	10
Residues (slag and hardhead)	9,330	12,398
Unwrought	85,734	77,999
Semimanufactures	19	2
Titanium:		
Ore and concentrate, ilmenite	153,531	112,248
Oxide	153	97
Tungsten ore and concentrate	375	279
Zinc:		
Oxide	458	30
Metal including alloys:		
Scrap	153	187
Blue powder	1	7
Unwrought	127	292
Semimanufactures	162	134

See footnotes at end of table.

Table 2.—Malaysia: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS—Continued		
Zirconium ore and concentrate	20,036	10,407
Other:		
Ores and concentrates	586	529
Ash and residue containing nonferrous metals	1,027	1,025
Oxides, hydroxides, peroxides of metals, n.e.s	274	3
Metals including alloys, all forms	(2)	22
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	2	2
Grinding and polishing wheels and stones	107	48
Asbestos	3	3
Barite and witherite	3,537	5,342
Boron materials, crude	4	5
Cement	40,967	22,718
Chalk	13	1
Clays and clay products (including all refractory brick):		
Crude:		
Kaolin	14,618	9,865
Bentonite	5	7
Fuller's earth	7	57
Other clays	625	997
Products:		
Refractory	2,942	1,932
Nonrefractory	10,204	8,358
Diamond—value, thousands	--	$207
Diatomite and other infusorial earth	2	6
Feldspar, fluorspar, etc	107	41
Fertilizer materials:		
Crude, phosphatic	3,988	53
Manufactured:		
Nitrogenous	7,139	1
Phosphatic	137	--
Potassic	114	--
Other, including mixed	20,014	10,036
Ammonia	280	161
Graphite	1	2
Gypsum and plasters	262	78
Lime	6,823	16,392
Magnesite	520	5
Pigments, mineral:		
Natural, crude	9	23
Iron oxides, processed	--	9
Pyrite	--	1
Salt and brine	840	2,646
Sodium and potassium compounds, n.e.s.:		
Caustic soda	415	202
Caustic potash, sodic and potassic peroxides	36	13
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	272	566
Worked	339	301
Dolomite, chiefly refractory grade	3,115	634
Gravel and crushed rock	892,738	972,083
Limestone, except dimension	47,465	25,277
Quartz and quartzite	123	184
Sand excluding metal bearing	33,458	51,624
Sulfur:		
Sulfuric acid	88	20
Elemental	10	40
Talc, steatite, soapstone, pyrophyllite	387	283
Other:		
Crude	291	257
Oxides, hydroxides, peroxides of barium, magnesium, strontium	1	(2)
Slag, dross, and similar waste, not metal bearing	38	7
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	33	9
Carbon black and gas carbon	34	17
Coal and coal briquets	10	29
Coke and semicoke	378	186
Hydrogen, helium, rare gases—value	$73,724	$88,236
Petroleum:		
Crude—thousand 42-gallon barrels	20,867	24,583
Partly refined—do	7,108	4,207

See footnotes at end of table.

Table 2.—Malaysia: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
MINERAL FUELS AND RELATED MATERIALS—Continued			
Petroleum—Continued			
Refinery products:			
Gasoline	thousand 42-gallon barrels	347	243
Jet fuel	do	46	3
Kerosine	do	1,169	611
Distillate fuel oil	do	1,674	4
Residual fuel oil	do	11	[2]
Lubricants	do	255	203
Other:			
Mineral jelly and wax	do	[2]	[2]
White spirit	do	2	8
Nonlubricating oils, n.e.s	do	6	11
Bitumen and bituminous mixtures, n.e.s	do	26	2
Liquefied petroleum gas	value	$129,236	$477,394
Unspecified	thousand 42-gallon barrels	2,420	[2]
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		276	483

[1] Data for 1974 include exports between the States of Malaysia (Sabah, Sarawak, and West Malaysia). Data for 1975 exclude intra-State trade.
[2] Less than ½ unit.

Table 3.—Malaysia: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite	500	508
Oxide and hydroxide	4,089	4,332
Metal including alloys, all forms	19,401	12,528
Antimony metal	32	30
Arsenic trioxide, pentoxide, acid	3,305	5,413
Chromium:		
Chromite	--	127
Oxide and hydroxide	77	54
Cobalt oxide and hydroxide	2	25
Columbium and tantalum ores and concentrates	32	--
Copper:		
Ore and concentrate	12	5
Metal including alloys, all forms	7,126	7,241
Iron and steel:		
Ore and concentrate	[2]	32
Metal:		
Scrap	10,636	6,057
Pig iron, including cast iron	7,478	8,520
Sponge iron, powder, shot	379	265
Ferroalloys:		
Ferromanganese	3,300	1,407
Other	1,519	1,437
Steel, primary forms	44,775	14,109
Semimanufactures:		
Bars, rods, angles, shapes, sections	299,418	191,915
Universals, plates, sheets	353,935	227,602
Hoop and strip	48,164	17,771
Rails and accessories	11,427	5,731
Wire	42,213	14,102
Tubes, pipes, fittings	63,002	54,873
Castings and forgings, rough	2,482	2,508
Lead:		
Ore and concentrate	53	38
Oxides	2,074	697
Metal including alloys, all forms	3,994	3,312
Magnesium metal including alloys, all forms	5	1
Manganese:		
Ore and concentrate	1,179	1,047
Oxides	545	503
Mercury	142	1,150
Molybdenum metal	56	18
Nickel metal including alloys, all forms	503	365
Platinum-group metals including alloys	1,225	911

See footnotes at end of table.

Table 3.—Malaysia: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS—Continued			
Silver	troy ounces	40,047	15,086
Tantalum metal, all forms		6	19
Tin:			
Ore and concentrate		21,518	27,772
Slag and hardhead		700	770
Metal including alloys, all forms		378	190
Titanium:			
Ore and concentrate		136	27
Oxides		2,826	2,115
Tungsten ore and concentrate, gross weight		105	60
Zinc:			
Ore		2,409	41
Oxide		169	154
Blue powder		109	49
Metal including alloys, all forms		2,509	426
Zirconium ore and concentrate		492	206
Other:			
Ores and concentrates		224	131
Ash and residue containing nonferrous metals		571	266
Oxides, n.e.s		8	6
Metals including alloys, all forms		8	188
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, etc		239	220
Dust and powder of precious and semiprecious stones	value	$54,672	$2,764
Grinding and polishing wheels and stones		--	674
Asbestos		19,209	19,932
Barite and witherite		3,232	9,545
Boron materials:			
Crude natural borates		66	48
Oxides and acids		88	202
Cement		300,472	466,147
Chalk		368	280
Clays and clay products:			
Crude:			
Bentonite		1,036	2,307
Kaolin		1,460	1,313
Fuller's earth		3,498	2,490
Mullite, chamotte, dinas earth		119	4
Other		10,196	2,859
Products:			
Refractory		13,058	11,131
Nonrefractory		9,522	7,983
Cryolite and chiolite		(2)	--
Diamond:			
Gem, not set or strung	value, thousands	$2,374	$2,971
Industrial	do	$17	$14
Diatomite and other infusorial earth		307	24
Feldspar		6,763	2,497
Fertilizer materials:			
Crude:			
Nitrogenous		23	157
Phosphatic		136,761	140,698
Potassic		610	928
Manufactured:			
Nitrogenous		158,381	64,809
Phosphatic:			
Thomas slag		152	--
Other		9,658	5,103
Potassic		176,076	168,418
Other, including mixed		79,855	35,849
Ammonia		33,718	7,918
Fluorspar, leucite, etc		7,458	1,308
Graphite, natural		367	357
Gypsum and plasters		54,960	51,050
Lime		3,648	6,462
Magnesite		623	180
Mica, worked and unworked, including waste		48	103
Pigments, mineral:			
Natural, crude		567	87
Iron oxides		1,292	574
Precious and semiprecious stones, except diamond:			
Natural,	value	$202,664	$729,117
Manufactured	do	$9,926	$51,371
Pyrite		--	13
Salt and brine		85,516	115,763

See footnotes at end of table.

Table 3.—Malaysia: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
NONMETALS—Continued			
Sodium and potassium compounds, n.e.s.:			
Caustic soda		11,891	6,481
Caustic potash, sodic and potassic peroxides, natron		29,387	16,874
Stone, sand and gravel:			
Dimension stone, crude and worked		2,864	4,202
Dolomite, chiefly refractory grade		568	520
Gravel and crushed rock		23,901	1,159
Limestone, except dimension		1,302	516
Quartz and quartzite		46	24
Sand excluding metal bearing		1,479	1,005
Sulfur:			
Elemental		17,729	16,205
Sulfur dioxide		11	3
Sulfuric acid		443	496
Talc, steatite, soapstone, pyrophyllite		4,732	3,182
Other:			
Crude		40,483	22,149
Slag, dross, and similar waste, not metal bearing		295	59
Oxides and hydroxides of magnesium, barium, strontium		131	182
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		3,880	1,290
Carbon black		10,177	6,171
Coal and coke and briquets:			
Anthracite and bituminous coal and briquets		19,020	15,985
Lignite and lignite briquets		15	[2]
Coke and semicoke		46,223	10,509
Hydrogen, helium, rare gases	value	$453,416	$308,976
Peat		107	69
Petroleum:			
Crude	thousand 42-gallon barrels	24,088	20,466
Partly refined	do	2,493	2,581
Refinery products:			
Gasoline	do	2,074	1,397
Jet fuel	do	818	81
Kerosine	do	1,076	978
Distillate fuel oil	do	7,346	4,601
Residual fuel oil	do	1,304	1,950
Lubricants	do	774	430
Other:			
White spirit	do	47	23
Mineral jelly and wax	do	49	40
Nonlubricating oil	do	81	42
Petroleum coke	do	95	1
Bitumen and other residues	do	135	133
Liquefied petroleum gas	value, thousands	$8,576	$8,608
Unspecified	thousand 42-gallon barrels	2	1
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		1,828	2,159

[1] Data for 1974 include trade between the States of Malaysia (Sabah, Sarawak, and West Malaysia). Data for 1975 exclude intra-State trade.

[2] Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—Bauxite was mined at two sites at Telok Ramunia in Johore State (West Malaysia) by Southeast Asia Bauxites Sdn. Bhd. (a subsidiary of Alcan). Mine output, down 6% from that of 1975, totaled 660,235 tons in 1976. Ore reserves at Telok Ramunia were estimated to be about 10 million tons, which represents a 17-year life for this operation at the current mining rate. Moreover, mine production has been diminishing annually owing to lower grade ore rather than decreased export demand. Because Malaysia lacks smelter facilities, its bauxite production was exported, and as in previous years, mostly to Japan. In 1976, exports to Japan totaled 512,474 tons valued at $9.2 million.

The Sabah and Sarawak State governments approached Reynolds Metals Co. to study the feasibility of constructing smelter facilities at Labuan and Bentulu, respectively. Initial plans called for site examination for a 100,000-ton-per-year smelter and port facility and a construction schedule.

Copper.—Production from the Mamut porphyry copper mine managed by Overseas Mineral Resources Development (OMRD) Sabah Bhd. began in May 1975. OMRD Sabah is a joint venture between seven Japanese companies and Malaysian interests. Mine ore output capacity per day was estimated at 16,000 tons, grading 0.59% copper and 0.02 troy ounce per ton gold. Total production of copper concentrate grading 28% copper in 1976 was close to 78,000 tons compared with the planned annual capacity of 120,000 tons. A shipping port constructed at Usukan Bay, 115 kilometers northwest of the mine, consists of a 9,000-ton-capacity stockyard, a 400-meter-long jetty with 30-inch belt conveyors, and a platform with shiploader. At full capacity, sixty 8-ton dump trucks will be used to transport the copper concentrate from the mine site to the port. In 1976, 73,941 tons of copper concentrate, valued at $25.8 million, was shipped to Japan for smelting and refining.

Iron Ore.—Since the Bukit Ibam mine was closed at Rompin in 1970, mine production of iron ore has declined annually. Total output in 1976 was 308,184 tons, a decrease of 11% from that of 1975. Iron ore was mined from relatively small deposits in Pahang, Johore, Perak, and Kedah States, with Pahang accounting for about one-half of the total output. Although deposits of high-grade ore are known to exist in Malaysia, none contain sufficient reserves to support profitable mining.

Iron and Steel.—Malayawata Steel Berhad was the only steel producer in the country. Because of increased demand for steel products, the Sabah State government proposed plans to build a steelmill at the Likas industrial estate near Kota Kinabalu. A feasibility study was undertaken by the government, and a license was reserved for the State Economic Development Corp. to build a 40,000-ton-per-year steelmill, which will initially produce mild steel round bars for the construction industry. Austromineral of Austria was preparing a feasibility study on the construction of a 500,000-ton-per-year integrated iron and steel mill near Kuantan on the east coast where port facilities were under construction.

Tin.—Output of tin-in-concentrate totaled 63,401 tons in 1976, representing a decline for the fourth consecutive year. Production of tin metal by the Butterworth and Penang smelters was 77,297 tons in 1976 compared with a peak production during the past decade of 91,496 tons in 1970. However, Malaysia remained the world's largest producer of tin-in-concentrate and refined metal, as well as the world's largest exporter of tin. The decline in output was credtied to Government export assessments. Government revenues collected on tin exports were $82.9 million for the export duty levied, $33.4 million for the export surcharge, and $610.6 million in foreign exchange for tin sales.

Production of tin-in-concentrate was as follows, by type of operation: Gravel pump 49.9%, dredging 36.4%, dulang 4.8%, open casting 3.6%, underground 2.9%, and re-treatment and other 2.4%. Output by gravel pumping operations was down 5% from that of 1975 while production from dredging was up 4%. During 1976, 99 mines were closed down and, at yearend, 811 mines remained in operation. The breakdown of active mines at yearend was as follows, by type of opera-

tion (yearend 1975 data in parentheses): Gravel pump, 724 (810); dredges, 51 (55); open cast, 11 (12); and other, 25 (33). Concomitant to the decrease in mine production and the number of active mines, the labor force in the tin industry decreased from 54,800 in 1,137 mines during 1966 to 36,828 by yearend 1976 (39,736 at yearend 1975).

Malaysian imports of 73%-grade tin concentrate in 1976 totaled 12,757 tons. Receipts from Australia were 6,119 tons; Burma, 2,298 tons; Indonesia, 1,866 tons; Laos, 1,159 tons; and other, 1,315 tons. Exports of tin metal reached 82,162 tons in 1976 (77,999 tons in 1975). Shipments to the United States constituted 36% of total exports, followed by Japan 22%, the Netherlands 18%, and other countries 24%.

During 1976, Perbadanan Nasional Bhd. (Pernas), a public limited company of which the Government of Malaysia owns approximately 95% of the equity, purchased the controlling interest in London Tin Corporation Ltd., the world's largest privately-owned tin investment group and the largest holder of Malaysian tin mines. Pernas then reached an agreement with Charter Consolidated Ltd. to form a 50–50 joint venture that would consolidate each party's resources and dredging facilities under a new company, Pernas Charter Management. The tin concessions of Charter Consolidated were second only to those of London Tin. Through these acquisitions by Pernas, the Government of Malaysia controlled 36 of the 51 dredges in Malaysia as well as 24.1% of the tin industry in Malaysia.

Government taxes on the Malaysian tin industry, which were reportedly the highest in the world, were a major concern for the operating companies. In some instances, the export tax and the export surcharge on tin accounted for about 70% of the total profit of an operating company. In addition to the aspect of profitability, there was little new investment in the domestic tin industry owing to the Government's delay in issuing renewal of existing leases and not granting new mining leases to non-Malay firms. Another deterrent to non-Malay investment was that many known occurrences of tin lie in Malay Reserve Lands on which exploitation is limited to Malays or Malay-controlled entities. Under the New Economic Policy, a Government program for economic development, ownership in the industry was to be redistributed by limiting new land leases to Malays. As a result, ownership in the domestic tin industry would be held 30% by Malays, 40% by non-Malay Malaysians, and the remainder by foreigners.

In addition to London Tin and Charter Consolidated, major producers of tin concentrates in Malaysia included the following:

Producer	Location	Activity	Number of operations
Ayer Hitam Tin Dredging Malaysia Bhd.	south of Selangor	dredging	3
Berjuntai Tin Dredging Bhd	Kuala Selangor	do	7
Gopeng Consolidated Limited	Ipoh	open cast	1
Do	do	hydraulic	1
Do	do	gravel pumping	1
Idris Hydraulic Tin Ltd	do	do	1
Do	do	open cast	1
Kamunting Tin Dredging Ltd	near Taiping	dredging	2
Kinta Kellas Tin Dredging Co. Ltd	Kinta Valley	do	1
Do	do	open cast	1
Malayan Tin Dredging Ltd	near Kumpong Bajah	dredging	5
Pahang Consolidated Ltd	east coast of West Malaysia.	underground mining.	1
Pengkalen Ltd	Kinta Valley	dredging	1
Petaling Tin Bhd	southwest Selangor	do	2
Southern Kinta Consolidated Ltd	Bernam	do	2
Do	Kampur	do	1
Southern Malayan Tin Dredging Ltd	Kinta and Batang Padang	do	6
Sungei Besi Mines Malaysia Bhd	10 miles south of Kuala Lumpur.	open cast	1
Tanjong Tin Dredging Ltd	Kinta Valley	dredging	1
Tronoh Mines Malaysia Bhd	Perak	do	2

The tin ore reserves of Pahang's Bakak mine were estimated at 619,771 tons, with an average grade of 1.3% cassiterite.

Titanium.—The major mineral obtained from alluvial tin mining is ilmenite, an iron-titanium oxide. Malaysian ilmenite assays about 53% TiO_2, but higher grades (up to 65% TiO_2) have been recovered at Sungkai in Perak and at Petaling in Selangor. Production of ilmenite, all from West Malaysia, totaled 180,004 tons in 1976. During the year, Malaysian Titanium Corporation Sdn. Bhd., a joint venture of Pernas (40%), Empat Nombor Ekor Bhd. (30%), and Malayan Tin Smelting and Finance Co. Sdn. Bhd. (a subsidiary of Straits Trading Co. Ltd.), completed the construction of a titania plant at Lahat to utilize local ilmenite as a raw material. The company was licensed to use the Benelite process, an acid-leach process to convert ilmenite into a synthetic rutile (titanium oxide). By using the Woodhall-Duckham acid-regeneration process, 95% of the hydrochloric acid used in the leach circuit could be recovered and regenerated. The plant was to initially process 17,000 tons of ilmenite in 1976, 50,000 tons in 1977, 55,000 tons in 1978, and 60,000 tons in 1979. Adverse factors facing the company were startup technical difficulties, the sharp decrease in price of Australian rutile, and decreased demand for titanium.

Other Metals.—Recovery of other metallic minerals from tailings of dredging operations was as follows, in tons: Columbite, 46; scheelite, 16; zircon, 3,129; and the rare-earth minerals monazite, 1,879, and xenotime, 139. In addition to small quantities of wolframite concentrate produced as a byproduct of alluvial tin operations, the major source of tungsten production is a wolframite lode in Pahang. Gold production in 1976 totaled 4,538 troy ounces. Gold was recovered as a byproduct of tin dredging operations at Batang Padang and Kuala Lumpur and from small-scale mining operations in the Raub area and the Bau District in Sarawak.

NONMETALS

Cement.—Malaysia's value-added in the construction sector increased 7% in 1976 and was expected to accelerate in 1977 because of increased residential construction and public sector building projects. Domestic resources of limestone, granite, and sand and gravel are abundant and assure a readily available supply for the construction industry. Cement production, however, increased 17% in 1976 to about 2.1 million tons. The bulk of the production was by companies in West Malaysia. The price of cement remained stable inasmuch as price increases were subject to approval by the Ministry of Trade. Moreover, the total supply of cement on a countrywide basis was adequate to meet the domestic demand.

During 1976, Tasek Cement Bhd. in Ipoh was completing an expansion program to double its production capacity to 1,040,000 tons per year at a cost of $24 million. When completed in early 1977, Tasek Cement would be the largest producer in Malaysia and one of the most advanced in Southeast Asia because of the installation of X-ray analyzing equipment, computerized process controls, and other technical innovations for energy conservation and environmental protection. Other cement production was as follows, in thousand tons per year: Associated Pan Malaysian Cement Sdn. Berhad, 750; Cement Industries of Malaysia Sdn. Berhad, 400; and Malaysia Industrial and Mining Corp. Berhad, 60. The Government approved two additional cement projects, Siemen Perak Sdn. Bhd. and Phang Cement Sdn. Bhd.

Fertilizer Materials.—During 1976, domestic production of nitrogenous, phosphatic, and potash fertilizers totaled 272,000 tons. Three of the more than twenty companies accounted for about 35% of the total production. In order to meet the domestic demand for fertilizers, about 400,000 tons of fertilizers was imported in 1976, consisting mainly of potassic fertilizers (45%), urea (21%), and composite, complex, and compound fertilizers (19%). The major suppliers of fertilizer materials were Christmas Island, Canada, the Federal Republic of Germany, Japan, and the United States.

To maintain reasonable prices for fertilizers, the Government introduced subsidy schemes and also included fertilizers in the essential commodities list under the Control of Supplies Regulations. Moreover, import duty exemptions were granted on all types of imported fertilizers except those produced locally; on these, a

protective import duty of about $18 per ton was levied.

Domestic demand for fertilizers was expected to increase at an annual rate of 3%. Domestic production was projected to increase 9% per year to 1978. During September 1976, Petronas initiated a feasibility study on establishing a urea project in Malaysia under the sponsorship of ASEAN's regional industrialization scheme. The study, to be completed in late 1977, centered on building a nitrogen fertilizer complex at Port Dickson that would have a capacity of 330,000 tons per year of nitrogen in ammonia and 304,000 tons per year of nitrogen in urea. Proposals to include production capacity for ammonium sulfate and nitrogen-phosphorus-potassium fertilizers were also included.

Other Nonmetals.—Production of crushed rock was about 11.3 million tons in 1976. The major producing States were Selangor, Johore, Pahang, and Perak. Crushed granite, most of which was used for road metal and concrete aggregate, constituted 68% of total production. The remainder was predominantly limestone, of which about 50% was used for road metal and concrete aggregate, 40% for cement manufacture, and 10% for various specialty uses. During the year, there were 100 granite quarries, 68 limestone quarries, and 21 unspecified quarries being worked in 11 States.

Sand and gravel production by 322 operations in 10 States totaled nearly 1.9 million tons in 1976. Almost all of the output was used as concrete aggregate. Perak, Johore, Penang, and Pahang, in that order, were the major producing States.

Kaolin production in 1976 was about 30,000 tons. Part of the output was consumed locally by the ceramic, paint, rubber, plastics, and pesticide industries; the remainder was exported to Japan and Singapore. Production of ball clay and common clay was not reported. However, domestic ball clay, obtained mostly from alluvial tin operations, was used with kaolin for manufacturing wall, floor, and mosaic tiles, and sanitary- and tableware. Common clay was used primarily in drainage and sewer pipes, flower pots, and similar uses.

Output of quartz sand and powder, primarily from sand deposits in Johore and from tin tailings operations, was 56,100 tons and 8,160 tons, respectively. Most of the quartz was used locally by the glass and ceramic industries, and some quartz sand was exported to Singapore. Barite production in 1976 was 6,096 tons, all from the Tasek Chini deposit in Pahang, which was estimated to contain 508,000 tons of barite. One plant in Selangor extracted feldspar from granite for use as a flux in the production of sheet glass.

MINERAL FUELS

Natural Gas.—As a result of the increase in crude petroleum production, output of associated natural gas averaged about 355 million standard cubic feet per day by August 1976. There is no commercial utilization of associated natural gas in Malaysia. Only about 20% was collected and used (15% consumed as fuel in exploration and production activities and 5% sold to Sarawak Electricity Supply Co. and to brick manufacturers in Miri, Sarawak). The remainder was simply flared.

Nonassociated natural gas fields occur offshore Sarawak and West Malaysia. Currently there is no commercial production from these fields. Petronas continued negotiations with Shell Oil Co. and Mitsubishi Corporation of Japan for construction and operation of a natural gas liquefaction plant to utilize gas from the Central Luconia Fields in Sarawak. If an agreement is reached, the $1 billion proposed plant would have an annual capacity of about 6 million tons of liquefied natural gas.

Petroleum.—Although 19 oilfields of commercial value have been discovered in the offshore areas of Sabah, Sarawak, and West Malaysia, only 8 were in production in 1976, producing a total of 60.5 million barrels during the year. Sarawak Shell operated six fields in Sarawak with a combined production rate of about 116,213 barrels per day in 1976 from West Lutong, Baram, Baronia, Tukau, Bakau, and Fairley Baram. The second largest producer, Sabah Shell, operating its only field at Samarang, was expected to increase its output from 27,500 barrels to 64,300 barrels per day by yearend 1976. Similarly, Exxon was expected to maintain the production rate at its Tembungo

Field of 11,300 barrels per day in 1977.

Exxon discovered promising oilfields in Pulai, Tapis, Bekok, and Siligi off the east coast of West Malaysia in the South China Sea, contracted the area, and signed a production-sharing agreement with Petronas in December 1976. Production from Exxon's new oilfields off the Trengganu coast was expected to come onstream in mid-1978 at an initial rate of 5,000 barrels per day.

Promising oil sites discovered by Continental Oil Company of Malaysia (Conoco) were at Sotong, Anding, and Duyong, which are situated a few miles to the south of Exxon's exploration areas. Duyong is the only natural gas field found to date off West Malaysia. Conoco has not contracted for a production-sharing agreement as yet, citing a need for further detailed study. Neither Conoco nor Exxon reported any operations in West Malaysia in 1976.

During the year, 10 exploratory wells and 41 development wells were drilled compared with 27 and 42, respectively, in 1975. Sarawak Shell drilled 5 exploratory wells and 23 development wells in East Malaysia, mainly in the Baronia and Tukau Fields. The company also conducted seismic surveys on land and offshore. On November 30, 1976, Sarawak Shell relinquished 37,036 square kilometers of onshore and offshore acreage.

Sabah Shell conducted a seismic survey and drilled five exploratory and appraisal wells offshore Sabah. The company also drilled 18 development wells in the Samarang Field. On November 30, 1976, Sabah Shell relinquished a small part of its acreage, the islands of Labuan and Gaya and their territorial waters.

Oceanic Group, Sabah Teiseki Oil Co., and Aquitaine Petroleum Co. (South East Asia) reported no activities in 1976; Aquitaine relinquished its acreage on August 11, 1976. With the prospect that Exxon's Pulai and Tapis Fields in West Malaysia would come into production by mid-1978 and the possibility of production from Sabah Shell's fields at Erb West in offshore Sabah, crude oil production in Malaysia was projected to reach 76.7 million barrels per year by yearend 1978.

The intake of crude oil by the three refineries in Malaysia (the Shell and Exxon refineries at Port Dickson and the Shell refinery at Lutong, Sarawak) averaged about 98,740 barrels per day. About 20% of the domestic production of crude oil was consumed locally for refining. The refinery at Lutong uses only local crude oil; the Port Dickson refineries were designed to refine feedstock in the ratio of 70% imported heavy crude oil to 30% locally produced crude oil. Moreover, the product mix of the output at the Port Dickson refineries meet more of Malaysia's demand, 45% of which was for middle distillates such as diesel fuel and kerosine. Additionally, Malaysia benefits from the export of local crude since this lighter grade commands a higher unit price. In view of the projected increase in domestic consumption of petroleum products, the Government planned to establish another refinery at the end of the Third Malaysia Plan.

The Mineral Industry of Malta

By Roman V. Sondermayer [1]

The mineral industry of Malta, a small country situated south of Sicily covering 122 square miles of islands, the largest of which are Malta and Gozo, consisted primarily of salt and limestone production during 1976. Its modest demand for fuels, construction materials, fertilizers, diamond, and metals was met through imports. The country's gross national product (GNP) for 1976, according to preliminary estimates, was $450 million. The value of output and employment in the extractive industry were not available. Unemployment was 4% and inflation was about 10% during 1976.

PRODUCTION AND TRADE

The 1974–76 trends in production of minerals in Malta are shown in table 1.

The value of mineral exports, mostly reexports of fuels for bunkering, was 15% of Malta's total exports. Domestic output of limestone and salt was significant only to the local economy. The value of mineral imports, mostly fuels, was 13% of the country's total imports, with Italy as the major supplier. The size of the country and its manufacturing industry limited demand for imported mineral products. Malta imports modest quantities of a variety of mineral commodities, mainly fuels for transportation and household use. Minor quantities of metals and nonmetals were imported to meet the demand of craft shops and the construction industry. The value of trade in mineral commodities in 1975 is shown in table 2.

[1] Physical scientist, International Data and Analysis.

Table 1.—Malta: Production of mineral commodities

Commodity		1974	1975	1976 p
Lime	thousand metric tons	39	34	e 35
Limestone	thousand cubic meters	658	740	NA
Salt	metric tons	327	279	e 270

e Estimate. p Preliminary. NA Not available.

Table 2.—Malta: Value of trade in mineral commodities in 1975

(Thousand dollars)

Commodity group	Exports and reexports	Imports
Oxides and hydroxides	6	156
Metals, including scrap:		
Iron and steel	849	16,420
Nonferrous metals	568	4,151
Cement	--	3,823
Fertilizer materials	6	306
Petroleum, crude and refinery products	18,792	32,193
Other	12	2,067

COMMODITY REVIEW

Metals.—Small quantities of imported steel nonferrous metals were consumed by Malta's modest manufacturing industry. In addition, precious metals were consumed by jewelers, and several diamond cutters operated modest facilities.

Nonmetals.—*Stone.*—Limestone was produced in various locations on Malta and Gozo. The largest quarries were situated near the capital city of Valletta. Debono Enterprises Ltd., at St. Paul's Bay, was among the major quarry owners and operators. In addition to its use for construction, stone from Malta was used by skilled craftsmen for ornamentation because it is easily carved. Balustrades, stone carvings, and stone-turned objects were produced and sold as souvenirs. Calcite stone, after polishing, was used for lampstands and other household accessories.

Other.—Salt was produced in Salina Bay on the island of Malta. The possibility of building a cement plant was virtually abandoned during 1976 largely for environmental reasons. Lime was in short supply, and during the year a feasibility study for a lime plant, using local limestone, was underway to determine the economic aspects of such a venture. Where the plant would be located and results of the study had not been made public by yearend.

Mineral Fuels.—All fuels, both liquid and gaseous hydrocarbons, were imported. Liquid hydrocarbons, mostly petroleum refinery products, were used by the transportation sector, in the production of electricity, and in households. Two fuel oil-operated power stations, with a combined capacity of 115 megawatts, supplied electric power to the islands. Besides the electricity-generating facilities, the power station complex included four 1-million-gallon-per-day seawater distillers; the fresh water produced is pumped to the Luga and Ta' Qali water reservoirs. The powerplants and seawater distillers were operated by the Malta Electricity Board, a public corporation.

Liquefied petroleum gas (LPG) was also imported, and the Malta Gas Board operated an LPG bottling plant at B'Bugia, on Malta, with storage capacity for 800 tons of LPG. Plans were made to increase that capacity to 1,100 tons. The Board distributes gas cylinders by truck to individual households. For bulk deliveries of LPG, the Board has large truck tankers.

The idea of constructing a petroleum refinery was abandoned on the grounds of the adverse environmental impact of refinery operation on a small island. During 1976, no offshore wells were drilled; sea boundaries between Malta and other countries were not yet determined.

The Mineral Industry of Mexico

By Roland W. Merwin [1]

Mexico's gross domestic product (GDP) at current prices was $78,637 million,[2] compared with the revised GDP of $79,016 million in 1975. The mining sector contributed 0.9% in 1976, the same as the revised 0.9% in 1975, while the petroleum sector accounted for 5.1% compared with 4.8% in 1975.

Mexico's foreign exchange rate, which had been maintained at 12.50 pesos to the U.S. dollar since 1954, was allowed to float through September 1976. By yearend it had dropped to approximately 20 pesos to the dollar. During 1976 it averaged 15.45 pesos to the dollar. There was an inflation rate of approximately 20% in 1976.

Government Policies and Programs.—The trend toward greater Governmental control and ownership of the mineral industry continued. The rationale for this was the belief in Government circles that such a policy was necessary owing to the lack of private Mexican equity capital for developing the mineral industries, and to the disinclination of the Government to allow the entry of foreign equity capital, except on a minority basis, into Government-owned or -controlled corporations.

The new policies were outlined in the Mining Law of 1975 which fundamentally changed the Mining Law of 1961 as related to nonfuel minerals. Provisions of the new law were enumerated in the 1975 edition of this chapter. Most of the provisions encountered strong opposition from the private mining sector in Mexico, as represented by the Camara Minera de Mexico (CMM).

Following prolonged negotiations between the Government and CMM, the official regulations implementing the Mining Law of 1975 were issued in late November 1976. The regulations appeared to represent a compromise between the widely varying positions of the Government and CMM. However, it was thought that the method and degree of strictness of their enforcement would be much more important than the content of the law and its regulations. If the Government was intent on expanding its share of the mining industry, it would be able to virtually freeze the private sector out of future expansion.

A major policy decision facing the Government at yearend 1976 was the position to be taken on expansion of Mexico's petroleum industry. Petróleos Mexicanos, S.A. (PEMEX), the autonomous Government-owned organization having exclusive control over the Mexican petroleum industry from exploration through marketing, was in the process of developing very large reserves of crude petroleum and associated natural gas in the southern States of Chiapas and Tabasco, commonly referred to as the "Reforma trend." Informed authorities in Mexico have speculated that such petroleum reserves could exceed 30 billion barrels and could support exports of about 1 million barrels per day of crude oil, in contrast to current exports of approximately 150,000 barrels per day. Additionally, it was believed that the associated natural gas production would be large enough to support large exports of natural gas to the U.S. market.

At yearend 1976, it was becoming increasingly apparent that high levels of exports of crude petroleum, refined products, and natural gas would largely solve Mex-

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[2] Where necessary, values have been converted from Mexican pesos (Mex$) to U.S. dollars at the rate of Mex$12.50=US$1.00 for 1975 and Mex$15.45=US$1.00 for 1976.

ico's pressing financial problems. PEMEX, on the other hand, stated in 1976 that the high reserve figure was not yet fully proved. Additionally, PEMEX would prefer to develop the region more slowly and, in effect, retain the prospective petroleum reserves for the nation's future industrial needs, rather than export a nonrenewable national resource for immediate financial gain. This is a basic philosophical difference that has long prevailed in Mexican Government circles as related to other minerals, and it appeared that it could only be resolved at very high Government levels.

PRODUCTION

Mexico's mining industry, exclusive of construction materials, has been largely based on the production of lead, zinc, silver, fluorspar, and sulfur. Lead, zinc, and silver mine output increased substantially over that of 1975. However, the production of fluorspar decreased substantially and there was virtually no change in the production of sulfur compared with that of 1975.

On the basis of preliminary data covering 18 metallic and 21 nonmetallic minerals, it was estimated that the production value of Mexico's mining industry decreased 6% from a revised $1,050 million in 1975 to $982 million in 1976. The apparent decline in mineral production value was accounted for by the devaluation of the Mexican peso. When stated in pesos the production value increased 15% over that of 1975.

Mexico's crude petroleum production rose to 267 million barrels in 1976 from 262 million barrels in 1975, an increase of 2%. The sales value of marketable products, including exports, decreased 7% from a revised $2,745 million in 1975 to $2,564 million in 1976. Again, the apparent decline in sales value was owing to the devaluation of the Mexican peso; in terms of local currency the sales value increased 17%.

Data on mineral production are shown in table 1.

Table 1.—Mexico: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 p
METALS			
Aluminum, primary	41,144	39,914	42,359
Antimony:			
Mine output, metal content	2,407	3,137	2,546
Metal (in mixed bars)	871	972	593
Arsenic, white [2]	9,505	6,158	5,499
Bismuth, content of exported concentrate, bullion, and refined metal	718	445	557
Cadmium:			
Mine output, metal content	1,960	1,581	1,844
Metal, refined	527	586	710
Copper:			
Mine output, metal content	82,670	78,196	88,970
Metal:			
Blister	78,310	76,374	85,175
Refined	68,201	63,149	75,418
Gold:			
Mine output, metal content—troy ounces	134,454	144,710	162,811
Metal, refined—do	127,285	132,236	150,722
Iron and steel:			
Iron ore:			
Gross weight [3]—thousand tons	5,007	5,054	5,466
Metal content—do	3,338	3,369	3,644
Pig iron and sponge iron—do	3,206	2,962	3,517
Ferroalloys—do	81	98	81
Crude steel—do	5,138	5,272	5,279
Steel semimanufactures—do	4,188	4,135	3,959
Lead:			
Mine output, metal content	218,021	178,615	200,027
Smelter (in refined and mixed bars)	200,180	172,928	190,242
Manganese ore:			
Gross weight [4]	403,134	428,459	422,570
Metal content	145,128	154,245	152,125
Mercury, mine output, metal content—76-pound flasks	25,933	14,214	15,026
Molybdenum, mine output, metal content	43	17	16
Nickel, mine output, metal content	25	50	56
Selenium, metallic	50	58	58
Silver:			
Mine output, metal content—thousand troy ounces	37,546	38,029	42,640
Metallurgical products, metal content—do	34,987	36,599	40,215
Tin:			
Mine output, metal content	400	378	481
Smelter, primary [5]	1,200	1,000	800
Tungsten, mine output, metal content	309	277	235
Zinc:			
Mine output, metal content	262,716	228,851	259,183
Smelter, primary	136,887	153,959	171,341
NONMETALS			
Asbestos	5	26	1
Barite	271,710	299,985	270,063
Cement, hydraulic—thousand tons	10,595	11,612	12,582
Clays:			
Bentonite	61,185	32,507	55,583
Fuller's earth	53,861	38,197	20,108
Kaolin	93,372	120,440	71,350
Refractory	138,353	106,336	--
Diatomite	23,630	22,723	26,294
Feldspar	185,304	143,808	73,239
Fertilizer materials:			
Crude, phosphate rock	194,095	282,480	224,428
Manufactured:			
Nitrogenous, gross weight—thousand tons	994	1,064	1,176
Phosphatic, gross weight—do	505	523	502
Mixed, gross weight—do	338	e 390	NA
Fluorspar, all grades—do	1,112	1,089	897
Graphite, all grades	62,551	60,814	60,337
Gypsum and anhydrite, crude—thousand tons	1,387	1,256	1,414
Magnesite	22,126	39,523	23,186
Mica, all grades	844	620	1,303
Perlite	12,136	19,066	14,555
Salt, all types—thousand tons	5,508	5,354	4,591
Soda ash (sodium carbonate)	403	411	390
Stone, sand and gravel:			
Calcite, common	5,504	7,634	4,902
Dolomite	426,717	348,749	347,007
Limestone [6]—thousand tons	3,456	4,652	4,763
Marble	5,694	2,693	2,449

See footnotes at end of table.

Table 1.—Mexico: Production of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
NONMETALS—Continued				
Stone, sand and gravel—Continued				
Quartz, quartzite, glass sand		513,984	518,973	509,029
Cobblestone		5,081	3,477	NA
Strontium minerals		29,545	14,722	22,157
Sulfur, elemental:				
Frasch process	thousand tons	2,257	2,074	2,054
Byproduct from natural gas	do	65	90	96
Total	do	2,322	2,164	2,150
Sulfates, natural sodium		148,271	300,121	228,025
Talc		2,649	1,480	192
Wollastonite		1,984	543	1,414
MINERAL FUELS AND RELATED MATERIALS				
Carbon black [e]		34,000	36,000	41,000
Coal, bituminous	thousand tons	5,166	5,193	5,650
Coke:				
Metallurgical	do	2,034	2,058	2,152
Imperial	do	17	12	21
Breeze	do	20	18	16
Total	do	2,071	2,088	2,189
Gas:				
Manufactured, all types		211,751	[e] 212,000	NA
Natural:				
Gross production	million cubic feet	744,673	786,469	771,785
Marketable production	do	560,911	583,885	577,934
Natural gas liquids:				
Field condensate	thousand 42-gallon barrels	29	50	[e] 50
Other	do	28,416	32,665	34,154
Petroleum:				
Crude	do	209,826	261,540	267,320
Refinery products:				
Aviation gasoline	do	409	522	565
Other gasoline	do	64,922	66,504	76,366
Jet fuel	do	5,734	5,275	6,179
Kerosine	do	12,882	12,956	13,444
Distillate fuel oil	do	50,226	55,376	59,075
Residual fuel oil	do	62,296	65,441	78,217
Lubricants	do	2,759	3,024	3,103
Other:				
Liquefied petroleum gas	do	18,439	18,819	20,278
Asphalt	do	4,725	4,115	3,690
Unspecified	do	4,653	4,555	1,471
Refinery fuel and losses	do	13,411	11,380	11,405
Total	do	240,456	247,977	273,793

[e] Estimate. [p] Preliminary. NA Not available.
[1] In addition to the commodities listed, lime, pumice, and additional types of crude construction materials were also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.
[2] Calculated white arsenic equivalent of metallic arsenic content of products reported.
[3] Calculated from reported metal content on the basis of ore containing 66.67% iron.
[4] Calculated from reported metal content on the basis of ore containing 36% manganese.
[5] Estimate by the International Tin Council.
[6] Excluding that for cement production.

TRADE

Mexican exports were valued at $2,992 million in 1976, compared with $2,715 million in 1975, an increase of 10%. In 1976, nonfuel mineral exports were valued at $340 million, or 11% of total exports. The principal contributers to this sector were zinc, lead, sulfur, and fluorspar minerals and products valued at $243 million. Exports of petroleum and petroleum products were valued at $557 million in 1976, or 19% of total exports.

Mexican imports were valued at $6,032 million in 1976, compared with $6,058 million in 1975. Mineral imports were valued at $893 million in 1976, or 15% of total imports. The principal mineral import items in 1976 were iron and steel scrap and castings valued at $393 million and petroleum products valued at $318 million.

Available data on mineral exports and imports are shown in tables 2 and 3, respectively.

Table 2.—Mexico: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975 [1]	Principal destinations, 1975
METALS			
Aluminum:			
Oxide (alumina)	6	NA	
Metal including alloys, all forms	1,378	NA	
Antimony:			
Ore and concentrate, gross weight	6,587	8,288	United States 8,210.
Metal including alloys, all forms	98	275	United States 225; Italy 29.
Arsenic:			
Oxide, gross weight:			
White	5,328	3,255	United States 3,088; Brazil 109.
Black	(2)		
Speiss and similar materials, oxide content	72	NA	
Bismuth metal including alloys, all forms	838	405	United States 180; United Kingdom 106; Netherlands 51.
Cadmium:			
Concentrate and speiss, gross weight	660	NA	
Flue dust, metal content	462	369	All to United States.
Metal	441	444	United States 231; Brazil 96.
Copper:			
Ore and concentrate, gross weight	4,774	8,387	United States 4,829; Belgium-Luxembourg 3,558.
Copper sulfate	1,343	425	Brazil 338; United States 46.
Metal including alloys:			
Scrap	--	6	All to West Germany.
Unwrought and semimanufactures	14,551	12,137	United States 7,898; Japan 1,997; France 998.
Iron and steel:			
Ore and concentrate, gross weight	4	13,843	United States 13,501.
Metal including alloys:			
Scrap	327	2,500	All to United States.
Primary forms	--	316	Do.
Ferroalloys:			
Ferrosilicomanganese	--	182	NA.
Other	1,777		
Steel, primary forms	2	2,339	NA.
Semimanufactures	106,358	75,807	NA.
Lead:			
Ore and concentrate, gross weight	17,263	454	All to United States.
Oxides:			
Litharge	40,819	24,643	United States 11,558; Venezuela 4,004; Italy 1,813.
Red lead	3,377	1,503	United States 404; Brazil 288; West Germany 182.
Metal including alloys:			
Scrap	--	131	United Kingdom 55; United States 27; Canada 23.
Unwrought:			
Antimonial and other bars	5,348	3,352	United States 1,500; Netherlands 1,145; Venezuela 522.
Refined	108,104	97,955	Italy 30,377; United States 16,541; Brazil 13,165.
Semimanufactures	75	NA	
Manganese ore and concentrate, gross weight	264,695	194,091	Japan 151,001; United States 36,661.
Mercury ----76-pound flasks--	29,342	11,504	United States 6,289; Brazil 2,488; Argentina 1,120.
Nickel metal including alloys, all forms	6	NA	
Selenium:			
Elemental	20	42	United Kingdom 20; United States 18.
Matte, speiss, anode slimes, smelter residues	50	NA	
Silver:			
Ore and concentrate	18,922	32,140	NA.
Metal ----thousand troy ounces--	24,137	28,657	NA.
Tin:			
Ore and concentrate	--	5,550	All to United States.
Metal including alloys, all forms	17	(2)	All to Nicaragua.
Titanium oxide	--	71	Colombia 50; Ecuador 20.
Tungsten ore and concentrate, gross weight	349	3,053	United States 2,961.
Zinc:			
Ore and concentrate, gross weight	292,092	103,257	Netherlands 29,555; United States 28,544; Belgium-Luxembourg 13,624.
Oxide, white	11,606	6,908	United States 6,437.
Sulfate	7,351	3,060	United States 2,790; Canada 234.

See footnotes at end of table.

Table 2.—Mexico: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975 [1]	Principal destinations, 1975
METALS—Continued			
Zinc—Continued			
Metal including alloys:			
Scrap	--	4,813	Japan 4,398; United States 414.
Powder	2,105	8,645	All to United States.
Unwrought	73,711	86,471	United States 33,636; Brazil 16,235.
Semimanufactures	348	NA	
Other nonferrous base metals:			
Ores, concentrates, and metallurgical residues, except scrap	3,489	73	United States 69.
Metals, all forms	83	310	United States 130.
NONMETALS			
Abrasives, natural, n.e.s.:			
Emery	2	1	Mainly to Ecuador and Costa Rica.
Pumice	20	55	All to United States.
Asbestos	7	2	All to Nicaragua.
Barite and witherite	148,351	113,675	United States 113,236.
Cement	187,679	NA	
Clays and clay products:			
Crude:			
Bentonite	43	56	United States 50; Honduras 5.
Fuller's earth and other earth	28,039	11,011	Peru 3,546; Brazil 3,170; Colombia 842.
Kaolin (china clay)	5	31	All to Colombia.
Other	263	335	Guatemala 197; Peru 68; Ecuador 35.
Products:			
Refractory	302	NA	
Nonrefractory	161,955	NA	
Diamond, industrial—carats	30,000	140,000	All to Switzerland.
Diatomite and other infusorial earth	15,505	3,364	Argentina 1,615; Brazil 526; West Germany 305.
Feldspar	709	40	All to Venezuela.
Fertilizer materials:			
Crude, phosphatic	5,239	257	All to United States.
Manufactured:			
Nitrogenous, including urea	31,076	NA	
Phosphatic	65,248		
Potassic	943		
Other, including mixed	729		
Ammonia	4,525		
Fluorspar:			
Acid grade	546,097	360,765	United States 307,051; Canada 53,327.
Metallurgical grade	531,049	478,204	United States 400,006; Canada 75,979.
Graphite, natural	58,429	46,657	United States 46,627.
Gypsum:			
Crude—thousand tons	1,227	585	All to United States.
Calcined—do	11	16	All to Belgium-Luxembourg.
Lime	591	1,389	All to United States.
Mica	--	51	Do.
Perlite	2,614	2,282	Cuba 509; Venezuela 482; Brazil 477.
Precious and semiprecious stones, except diamond—kilograms	358	4,728	Japan 4,657.
Salt—thousand tons	4,470	3,653	Japan 3,151; United States 376; Canada 125.
Sodium and potassium compounds:			
Sodium compounds:			
Sodium carbonate	599	NA	
Sodium hydroxide	5,949	4,466	Argentina 3,880; Brazil 349.
Sodium sulfate	85,946	117,273	Brazil 82,291; Venezuela 18,854.
Potassium compounds	5	NA	
Stone, sand and gravel:			
Dimension stone	10,236	NA	
Crushed rock	18,805	NA	
Limestone, dolomite, calcite	1,967	NA	
Quartz and quartzite	4,407	3,339	All to United States.
Sand:			
Construction	3,546	NA	
Glass	23,979	10,978	Guatemala 10,897.
Strontium minerals	27,164	15,028	United States 14,972.

See footnotes at end of table.

Table 2.—Mexico: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975 [1]	Principal destinations, 1975
NONMETALS—Continued			
Sulfur:			
Elemental, all forms ----thousand tons--	1,906	1,368	United States 952; Lebanon 120; Brazil 96.
Sulfuric acid ----------	62	NA	
Vermiculite ----------	--	551	United States 550.
Wollastonite ----------	1,727	51	All to United States.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural (including gilsonite) ----------	65	6	All to Peru.
Carbon black ----------	1,950	2,213	United States 1,051; Venezuela 1,050.
Coal and coke ----------	5	7	All to United States.
Gas, natural ----------million cubic feet--	438	NA	
Peat ----------	--	17	NA.
Petroleum: [3]			
Crude ------thousand 42-gallon barrels--	1,924	38,311	NA.
Refinery products:			
Gasoline ----------do----	359	482	NA.
Distillate fuel oil ----------do----	2,295	471	NA.
Residual fuel oil ----------do----	7,757	1,380	NA.
Lubricants ----------do----	1	--	
Other:			
Liquefied petroleum gas----do----	4,930	201	NA.
Mineral jelly and wax ----do----	21		
Asphalt ----------do----	1,117		
Total ----------do----	16,480	2,534	

NA Not available.

[1] Consejo de Recursos Minerales. Anuario Estadistico de la Mineria Mexicana 1975. Mexico, D.F., 1976, 166 pp.

[2] Less than ½ unit.

[3] Source for 1975 data: U.S. Bureau of Mines International Petroleum Annual, 1975, 37 pp.

Table 3.—Mexico: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975 [2]	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate ----------	30,496	47,874	United States 32,539; Guyana 13,230.
Oxide and hydroxide ----------	102,255	88,906	United States 88,394.
Metal including alloys, all forms -------	46,884	12,705	United States 7,069; Japan 2,731.
Arsenic trioxide, pentoxide, acids ----------	23	NA	
Beryllium metal including alloys, all forms kilograms--	3,375	NA	
Bismuth metal including alloys, all forms do----	2,065	29,244	Belgium-Luxembourg 25,063; United States 4,181.
Cadmium metal including alloys, all forms do----	1,580	18,364	United States 16,682; West Germany 1,379.
Chromium:			
Chromite ----------	53,082	49,293	United States 40,704; Cuba 7,500.
Oxide and hydroxide ----------	133	NA	
Cobalt:			
Oxide and hydroxide ----------	120	91	Belgium-Luxembourg 83.
Metal including alloys, all forms -------	62	30	Belgium-Luxembourg 15; United States 15.
Columbium and tantalum, tantalum metal including alloys, all forms ----kilograms--	448	NA	
Copper metal including alloys:			
Scrap ----------	947	287	All from United States.
Copper sulfate ----------	1	NA	
Unwrought ----------	5,471	64	United States 58.
Semimanufactures ----------	1,383	NA	

See footnotes at end of table.

Table 3.—Mexico. Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975 [2]	Principal sources, 1975
METALS—Continued			
Gold metal, unworked or partly worked troy ounces	1,756	NA	
Iron and steel:			
Ore and concentrate, gross weight	37,203	34,144	Peru 34,141.
Metal:			
Scrap	793,162	1,163,743	United States 1,158,280.
Pig iron, including cast iron	53,896	NA	
Sponge iron, powder, shot	2,040	2,012	United States 1,899.
Ferroalloys	9,741	11,181	United States 7,129; Japan 2,747.
Steel, primary forms	151,725	122,321	United States 47,958; Japan 39,440; Switzerland 14,534.
Semimanufactures [3]	550,757	234,142	United States 142,903; Japan 44,761; West Germany 19,667.
Lead:			
Oxides	74	NA	
Metal including alloys, all forms	274	556	All from United States.
Magnesium metal including alloys, all forms	2,004	911	Do.
Manganese:			
Ore and concentrate	24,382	1,165	Do.
Oxides	1,709	681	United States 507; Japan 104.
Mercury 76-pound flasks	27	NA	
Molybdenum:			
Ore and concentrate, gross weight	981	NA	
Metal including alloys, all forms	8	14	All from United States.
Nickel:			
Matte, speiss, similar materials	818	2,659	United States 1,974; France 310.
Metal including alloys, all forms	2,215	529	United States 440; France 26.
Platinum-group metals, all forms:			
Palladium troy ounces	3,329	1,259	Switzerland 711; United States 548.
Platinum do	1,436	1	All from United States.
Other do	2,600	NA	
Rare-earth metals:			
Oxides and fluorides	79	NA	
Metals including alloys kilograms	48	NA	
Selenium, elemental do	5,751	NA	
Silver metal including alloys troy ounces	35,872	NA	
Tin:			
Ore and concentrate, gross weight	2,190	3,240	NA.
Oxides	39	40	United States 18; West Germany 11; United Kingdom 9.
Metal including alloys, all forms	462	NA	
Titanium:			
Ore and concentrate, gross weight	2,107	212	Australia 184; United States 27.
Oxides	762	NA	
Slag and residues	38,936	7,477	All from United States.
Metal including alloys, all forms	25	NA	
Tungsten metal including alloys, all forms	29	329	United States 327.
Uranium and thorium oxides kilograms	12	NA	
Vanadium pentoxide	268	554	United States 544.
Zinc:			
Oxides	230	334	United States 333.
Metal including alloys, all forms	297	65	Mainly from United States.
Zirconium ore and concentrate, gross weight	4,932	NA	
Other:			
Ores and concentrates, n.e.s	16,548	NA	
Ash and residue containing nonferrous metals	689	NA	
Oxides, hydroxides, peroxides of metals n.e.s	937	235	United States 166; France 30.
Metals including alloys, all forms:			
Metalloids:			
Phosphorus, elemental (white, black, red)	21,544	21,711	United States 21,461.
Silicon	1,289	622	United States 462; United Kingdom 61.
Other	14	NA	
Alkali and alkaline earth	3,312	NA	
Pyrophoric alloys kilograms	4,516	NA	
Base metals including alloys, all forms, n.e.s	415	NA	
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	1,416	67	United States 19; Netherlands 15.

See footnotes at end of table.

Table 3.—Mexico. Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975 [2]	Principal sources, 1975
NONMETALS—Continued			
Abrasives, natural, n.e.s.—Continued			
Dust and powder of precious and semiprecious stones, except diamond kilograms	3	NA	
Grinding and polishing wheels and stones	296	NA	
Asbestos, crude	56,919	60,981	Canada 28,610; United States 13,601.
Barite and witherite	162	9	All from United States.
Boron materials:			
Crude natural borates	1,830	14	United States 9; Japan 5.
Oxide and acid	2,032	1,784	United States 1,780.
Bromine	164	NA	
Cement	95,834	NA	
Chalk	(4)	NA	
Clays and clay products (including all refractory brick):			
Crude clays:			
Fuller's earth	830	NA	
Kaolin (china clay)	41,936	32,574	United States 32,070.
Refractory	130,847	48,989	United States 47,202.
Other	3,848	NA	
Products:			
Refractory (including nonclay bricks)	19,655	NA	
Nonrefractory ____value, thousands__	$466	NA	
Cryolite and chiolite	20	(4)	All from United States .
Diamond:			
Gem, not set or strung ____carats__	2,140	NA	
Industrial ____thousand carats__	4,895	NA	
Powder ____do____	4,805	NA	
Diatomite	247	344	Do.
Feldspar and nepheline syenite	2,641	2,259	United States 2,258.
Fertilizer materials:			
Crude:			
Nitrogenous [5]	10,214	6,650	United States 5,000; Chile 1,650.
Phosphate rock ____thousand tons__	1,492	791	United States 540; Morocco 230.
Manufactured:			
Nitrogenous	225,760	NA	
Phosphatic	139	NA	
Potassic	90,973	110,700	United States 105,669.
Other, including mixed	2,522	NA	
Ammonia	254,200	NA	
Fluorspar	27	(4)	All from United States.
Graphite, natural	337	1,256	United States 1,251.
Gypsum	33,842	22,938	United States 22,840.
Iodine	167	NA	
Lime	4,499	NA	
Magnesite	2,882	8,957	United States 8,954.
Mica:			
Crude, including splittings and waste	348	30	United States 19; Belgium-Luxembourg 4.
Worked, including agglomerated splittings	40	26	United States 22; West Germany 3.
Pigments, mineral:			
Natural, crude	30	NA	
Iron oxides, processed	98	NA	
Precious and semiprecious stones, except diamond:			
Natural ____kilograms__	5,316	919	United States 867; West Germany 50.
Manufactured ____do____	1,514		
Pyrite, unroasted	393	NA	
Salt	1,400	846	All from United States.
Sodium and potassium compounds:			
Caustic soda	44,445	58,376	United States 57,703.
Caustic potash, sodic and potassic peroxides	1,725	514	Denmark 296; West Germany 107; United States 96.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	7,283	NA	
Worked:			
Slate	635	NA	
Paving and flagstone	50	NA	
Other	7,236	NA	
Dolomite, chiefly refractory grade	536	NA	
Gravel and crushed rock	2,358	NA	

See footnotes at end of table.

Table 3.—Mexico. Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975 [2]	Principal sources, 1975
NONMETALS—Continued			
Stone, sand and gravel—Continued			
Limestone	54	NA	
Quartz and quartzite	5,258	1,839	Belgium-Luxembourg 840; United States 501.
Strontium	2	NA	United States 269,989.
Sulfur:			
Elemental:			
Other than colloidal	782	421	Mainly from United States.
Colloidal	161	NA	
Sulfuric acid and oleum	31,164	NA	
Talc, steatite, soapstone, pyrophyllite:			
Pyrophyllite	233	46	All from United States.
Steatite	102,148	88,463	United States 86,045.
Talc	515	320	United States 159; Italy 100.
Vermiculite	569	2,216	United States 1,981; Switzerland 139.
Other:			
Crude:			
Meerschaum, amber, jet	74	NA	
Other	1	NA	
Slag, dross, and similar waste, not metal bearing, from iron and steel manufacture	12,481	NA	
Slag and ash, n.e.s	179	NA	
Oxides and hydroxides of magnesium, strontium, barium	310	NA	
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	698	NA	
Carbon black and gas carbon:			
Carbon black	2,160	514	United States 481.
Gas carbon	1	3	All from United States.
Coal, all grades, including briquets	368,072	450,345	United States 450,123.
Coke and semicoke	171,544	113,010	United States 105,416.
Gas, hydrocarbon, natural—million cubic feet	11,561	NA	
Hydrogen, helium, rare gases	882	NA	
Peat, including peat briquets and litter	433	245	All from United States.
Petroleum:			
Crude—thousand 42-gallon barrels	9,482	--	
Refinery products:			
Gasoline—do	6,263	6,580	NA.
Kerosine—do	86	186	NA.
Distillate fuel oil—do	2,846	3,741	NA.
Residual fuel oil—do	822	7,388	NA.
Lubricants—do	108	411	NA.
Other:			
Liquefied petroleum gas [6]—do	10,041	4,640	NA.
Mineral jelly and wax—do	253		
Bitumen and other residues and bituminous mixtures, n.e.s.—do	126		
Petroleum coke—do	734		
Pitch and pitch coke—do	136		
Unspecified—do	199		
Total—do	21,614	22,946	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	15,376	NA	

NA Not available.

[1] Includes free trade materials in totals and in principal sources.

[2] Consejo de Recursos Minerales. Anuario Estadistico de la Mineria Mexicana 1975. Mexico, D.F., 1976, 166 pp.

[3] Does not include ingots of high-carbon and alloy steel.

[4] Less than ½ unit.

[5] May include a small quantity of manufactured materials.

[6] Includes that derived from natural gas plants.

COMMODITY REVIEW

METALS

Aluminum.—Alúmino S.A. de C.V., with a smelter near Veracruz, was Mexico's only primary aluminum producer in 1976. Using imported alumina, the smelter had a rated capacity of 45,000 tons of aluminum metal per year, and was capable of producing approximately 40% of Mexico's domestic requirements. Previously announced plans to double the capacity of the smelter had not progressed past the planning stage at yearend 1976.

During the year virtually no progress was made on the Government's plans to establish a 120,000-ton-per-year aluminum smelter at Coatzacoalcos, Veracruz. As planned, the smelter would be a joint venture of the Mexican and Jamaican Governments with Kaiser Aluminum & Chemical Corp. providing technical assistance.

Copper.—The Government gave priority attention, including strong financial support, to the development of a major copper industry in Mexico during 1976. If all of Mexico's projected new copper capacity were to come onstream as scheduled, Mexico's copper production would rise from 90,000 tons in 1976 to 500,000 tons in 1982, making Mexico one of the world's leading producers of copper.

Cía. Minera de Cananea S.A. de C.V., the nation's largest producer, completed an expansion program during 1976 which raised its capacity from the previous 40,000 tons of copper per year to 70,000 tons per year, and was planning to increase its capacity to 140,000 tons per year by 1982.

At yearend 1976, the Government-controlled Cía. Mexicana de Cobre, S.A., in which Industrial Minera Mexico S.A. (IMM) has a substantial minority interest, was well advanced on its programs of mine stripping and concentrator construction at its La Caridad mine at Nacozari, Sonora. Initial mining and milling operations at the rate of 140,000 tons of copper per year are scheduled for the spring of 1978. The ultimate capacity will be 250,000 tons of copper per year. La Caridad's copper-smelting and electrolytic-refining facilities at Empalme on the Gulf of California are scheduled for initial operations in early 1979.

In a closely related development, IMM was engaged in feasibility studies leading toward the development of the El Arco mine located near Guerrero Negro in Baja California across the Gulf of California from Empalme. In anticipation of the development of what appeared to be a major copper deposit at El Arco, the La Caridad smelter at Empalme was being built of sufficient size to treat concentrates from both La Caridad and El Arco.

Iron and Steel.—The year 1976 was a disappointing one for Mexico's iron and steel industry. At yearend, the installed steel ingot capacity was 9.9 million tons, whereas steel ingot production in 1976 remained virtually unchanged from that of 1975 at 5.3 million tons. As a result, most of the ambitious plans for expansion of the Mexican steel industry were deferred until conditions improved.

The Government-owned Cía. Siderúrgica Lázaro Cárdenas-las Truchas, S.A. (SICARTSA) in the State of Michoacán on the Pacific coast completed the first stage of construction, giving the firm an initial production capacity of 1.3 million tons per year of steel ingot. Construction continued on the second stage of the project which is designed to raise capacity to 3.65 million tons per year by 1980.

Lead and Zinc.—Industrias Peñoles, S.A., completed construction of a new lead smelter and refinery at Torreón, Coahuila, which had a capacity of 190,000 tons of lead per year. It will also produce gold and silver as byproducts.

IMM completed expansion and modernization programs at three of its major mines in Mexico. At the San Martin, Zacatecas, zinc-copper mine, production capacity increased 85%, and at the Charcas, San Luis Potosí, mine, lead and zinc capacity was increased 30%. The first phase of the expansion program at the Santa Barbara lead-zinc mine in Chihuahua was completed at yearend 1976, increasing ore production 25%.

Lead and zinc smelting and refining charges, which are set by the Government, were being reviewed to determine what new rates should apply in view of the devaluation of the peso, sharply increased electricity costs, and other cost increases. The study is expected to be completed in mid-1977.

Manganese.—Cía. Minera Autlan, S.A. de

C.V., completed construction work on its new high-carbon ferromanganese alloy plant at Tomas, Veracruz, reported to be one of the largest plants of its type in the world. In addition, it proceeded with a large-scale expansion program at its mine in Molango, Hidalgo.

Silver.—Although total silver production was below the projected goal, Mexico ranked as the world's leading silver producer in 1976. Industrias Peñoles, from its various holdings, accounted for most of the 42.6 million troy ounces produced.

Cía. Minera Las Torres began milling output from the Las Torres group of mines at Guanajuato, 400 kilometers northwest of Mexico City. This mining operation is owned by Industrias Peñoles (33%), Cía. Minera Fresnillo S.A. (37%), and Lacana Mining Corp. (30%). In 1976, mine output was 4 million troy ounces of silver and 40,000 troy ounces of gold. There are an estimated 4.3 million tons of proven and probable ore reserves grading 11.2 troy ounces of silver and 0.07 troy ounce of gold per ton.

A flotation plant of 1,200-ton-per-day capacity at Lacana's and Industrias Peñoles' Encantado mine at Coahuila should be operational in 1977. The Encantado mine has estimated proven and probable ore reserves of 3.2 million tons grading 13.2 troy ounces of silver and 7.6% lead per ton.

NONMETALS

Cement.—Despite the almost complete lack of growth in the construction industry, 1976 was a satisfactory period for Mexico's cement industry, largely because intensified export promotion efforts met with considerable success. Installed capacity at yearend 1976 was 13.6 million tons per year compared with 13.5 million tons at yearend 1975. Production during 1976 was approximately 92% of rated capacity. Almost all major plants within the industry were involved with additional capacity projects in 1976, even though the cost of these projects has been increased sharply by much higher prices for foreign-produced machinery following the devaluation of the peso.

Fertilizer Materials.—*Phosphate Rock.*—The Government-owned Roca Fosfórica Mexicana, S.A., in close cooperation with Consejo de Recursos Minerales, continued to make good progress in its programs to develop promising phosphate rock deposits in Baja California. Drilling has delineated deposits containing an estimated 600 million tons of ore with a geologic probability of additional tonnage in the immediate area. As much of the ore lies underground, a variety of underground mining methods were being experimented with to determine the best methods to be utilized. Investigations continued on the metallurgical treatment of the ore, with a small pilot-plant being installed in the latter part of 1976.

Fluorspar.—Mexico maintained its position as the world's largest producer of fluorspar and the major source of supply to the U.S. market. However, both production and exports declined sharply from those of 1975, because of reduced demand in the U.S. market.

The leading producers in 1976 were IMM, Industrias Peñoles, Minera Frisco S.A., La Dominica S.A. de C.V., and Minera Continental, S.A., all of which were private enterprises with foreign capital participation on a minority basis. Together they accounted for approximately 83% of the output in 1976. Despite the slowdown in demand, they were all proceeding with long-range plans for expansion. A large number of small miners accounted for the remaining 17% of the output in 1976.

The Instituto Mexicano de la Fluorita (IMF), in cooperation with the Government, was engaged in programs to improve the position of the fluorspar industry. Under one program, technical and financial assistance were being provided to smaller producers. Under a program to improve customer acceptance, considerable attention was being given to the briquetting and/or pelletizing of fluorspar products as the most acceptable form for steelmaking operations in the U.S. market.

Sulfur.—Production at Frasch-type operations did not vary greatly from that of 1975. However, sulfur exports dropped about 25% to 1 million tons in 1976 as a result of a sharp decline in world demand.

MINERAL FUELS

Coal.—Consejo de Recursos Minerales initiated a program of geologic mapping and drilling designed to delineate and characterize Mexico's extensive coal resources in the State of Coahuila in north-

ern Mexico. The main purpose of the study was to develop coal reserves that could be used for power generation by the Comisión Federál de Electricidád, the Government agency responsible for all electric power generation in Mexico.

Petroleum.—PEMEX had a very successful year. Not only did production increase substantially over that of 1975, but officially announced proven reserves increased from 5.3 billion barrels at yearend 1975 to 11.2 billion barrels at yearend 1976.

The improvement in the position of the Mexican petroleum industry continued to be largely based on the development of the Reforma trend region in southern Mexico. First brought into production in 1972, the Reforma trend is now recognized as one of the large petroleum provinces of the world, the extent of which had not yet been fully delineated. Including new fields discovered in 1976, the proved onshore producing area in the Reforma trend now stretches some 50 miles from south to northeast and 35 miles from east to west at the widest point. Additionally, an offshore development in late 1976 appeared to indicate that the Reforma trend would extend into the Gulf of Campeche.

At yearend 1976, approximately 100 producing wells in four fields in the Reforma trend were producing at the rate of 515,000 barrels per day. Of these fields, only one had been completely developed to the full production stage, while the other three were in the process of being fully developed. Thirteen other proven structures had only the discovery well and no production handling infrastructures.

Although the major portion of PEMEX's exploration and development efforts were related to the development of the Reforma trend region, other areas in Mexico continued to receive considerable attention. In one development of considerable interest, the drilling of a producing gas well in Baja California identified a new hydrocarbon zone in this area.

PEMEX completed 79 exploration wells in 1976 compared with 87 wells in 1975. Of these wells, 14 produced oil, 11 produced gas, and 54 were dry. PEMEX drilled 257 development wells in 1976 compared with 226 wells in 1975. Of these, 157 produced oil, 43 produced gas, and 57 were dry. Of the total development wells, 112 were in the Reforma trend area and were completed to an average depth of 10,500 feet.

PEMEX's installed primary refining capacity at yearend 1976 was 865,000 barrels per day compared with 785,000 barrels per day at yearend 1975. The primary refinery throughput averaged 737,500 barrels per day in 1976, an increase of 12% over that of 1975. At yearend 1976, plant additions and refinery construction were in progress to raise Mexico's primary refining capacity to approximately 1.5 million barrels per day.

The Mineral Industry of Morocco

By Janice L. W. Jolly [1]

The mineral industry of Morocco contributed about 4.4% to the gross domestic product (GDP) of 1976. Valued at $4.3 billion [2] in current prices, the GDP showed a real growth of 10% over that of 1975. Agriculture, Government investment, industry, and commerce were responsible for this growth, the largest since 1971. Revenues from phosphate and other minerals were down, with general mineral output stagnant. Morocco's ambitious investment plans, combined with rapidly expanding contract authorizations for future projects, continued to offer opportunities for foreign business. The Moroccan Investment Code continued to offer inducements to firms willing to accord local partners at least half ownership plus board chairmanship. In priority sectors such as mining and export industries, 100% foreign ownership was authorized.[3]

A significant event during the year was the acquisition of the Bu Craa phosphate deposits in Spanish Sahara. Following publication of an ambiguous advisory opinion on Spanish Sahara by the International Court of Justice in October 1975, the "Green March" of 350,000 unarmed Moroccan civilians took place into the Spanish colony. Spurred on by this development, the Spanish, Moroccan, and Mauritanian Governments signed an agreement on November 14, 1975, creating a tripartite administration for Spanish Sahara with final Spanish withdrawal slated for February 28, 1976. On April 14, 1976, the two remaining administrators implemented their claims to sovereignty over the area by dividing the territory between them. The northern two-thirds, which included the Bu Craa deposits, went to Morocco. The division was being actively contested by the Polisario Front and its political arm, the Saharan Democratic Arab Republic, with Algerian support. The ensuing conflict effectively stopped Bu Craa phosphate exports, although some mining continued.

The year 1976 was the 4th year of the current 5-year plan and many projects inaugurated as part of this plan were completed or nearing completion. Virtually all of them augmented infrastructure and represented potential for improving commerce. Important current projects included a steelmill complex at Nador, a petrochemical complex at Mohammedia, a chemical complex at Safi, and the extension of the oil refinery at Mohammedia. Construction of new ports at Nador and El Jorf Lasfar were underway. Construction of three powerplants and installation of six gas turbines and four power units began in 1976. A study was being made for a new railway to the south, linking Marrakech with Agadir and El Ayoun.

The Moroccan agency Direction des Mines et de la Geologie et de l'Energie and Hunting Geology and Geophysics Ltd. signed a contract for airborne and ground geophysical surveys over southern Morocco. The survey area included the western High Atlas, the Anti-Atlas, Jebel Sarhro, and Jebel Siroua. The project area covered about 165,000 square kilometers and would require a total of approximately 80,000 line-kilometers of flying. Of this, approximately 54,000 line-kilometers were to be flown with a high-sensitivity Geometrics G 803 proton magnetometer, and

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Moroccan dirhams (DH) to U.S. dollars at the rate of DH4.40=US$1.00.

[3] U.S. Embassy, Rabat, Morocco. State Department Airgram A-10, Jan. 24, 1977, 8 pp.

the remaining 26,000 line-kilometers were to be flown with both high-precision magnetometry and gamma ray spectrometry. All the data resulting from the surveys were to be compiled and interpreted by Hunting. A Japanese group was working in the Anti-Atlas, and the United Nations Development Program (UNDP) completed a survey program. Particular attention was being paid in these surveys to stratiform copper mineralization and lead-zinc deposits. Other projects contemplated for the near future were preparation of mineral maps at a scale of 1:500,000 and metallogenic maps at a scale of 1:1,000,000; a study of apogranitics and associated mineralization; and geologic and metallogenic studies of the Upper Moulouya Valley, the southern border of the Middle Atlas, the Oriental Rif, the Horst Region, and the Jebilet. High priority was being given to research for new sources of energy such as oil shale, lignite, geothermal, and uranium.[4] The Bureau de Recherches et de Participations Minières (BRPM) was also exploring for mercury and magnesium minerals in the "pre-Rif" area.

PRODUCTION AND TRADE

Mineral production, excluding petroleum, natural gas, and cement, was valued at $611.4 million in 1976. Phosphate rock accounted for 87% of the total value received, lead concentrate 3.3%, anthracite 2.4%, manganese ore (chemical grade) 1.5%, iron ore 1.1%, cobalt concentrate 0.8%, and zinc concentrate 0.7%. Petroleum production was down from the 1975 level, with 8,900 tons (approximately 62,300 barrels) produced in 1976.[5]

The principal exports were phosphates and lead, and the main imports were crude petroleum, industrial machinery and equipment, and iron and steel products. The trade deficit for 1976 was estimated at $1.4 billion, about 34.6% higher than that recorded for 1975. The principal cause of the deficit was the continued low receipts for phosphate exports. Imports were valued at $2.6 billion in 1976 and exports were valued at $1.2 billion. As during most of the preceding years, the United States continued as the second largest supplier to Morocco after France, closely followed by West Germany. In 1976, with $297 million of exports to Morocco, the United States accounted for 11.4% of Moroccan imports. Morocco exported manganese to the United States.

Although phosphate fertilizer markets remained relatively depressed throughout 1976, there was a marked improvement over those of 1975 as both phosphate rock and triple superphosphate exports increased and fertilizer consumption returned to its 1974 level. The massive 1974 escalation in phosphate rock prices by north African producers to about $65 to $70 per ton had an immediate and dramatic effect on world consumption. Most European countries cut usage about 20%, as did India and other developing countries. Market forces soon prevailed, however, and the prices were down to about $36 to $40 per ton f.o.b. Casablanca by 1976. During this period, as U.S. sources became available at lower prices, the European market became dislocated as plants closed down, and there was a shift from a position of net exporter to net importer of fertilizers. By 1976, as prices were forced down, European buyers were also increasing Moroccan imports. Even so, substantial surpluses of phosphoric acid, phosphate rock, and sulfur were being forecast up until 1981 and beyond.[6]

Although phosphate rock exports for the first half of 1976 were below those of 1975, the total for 1976 was 15.6 million tons, an improvement of 5% over 1975 phosphate rock exports. Revenues, however, were still below those of the peak 1974 year. The major proportion of the year's export sales were of Khouribga 70% to 72% tricalcium phosphate ($Ca_3(Po_4)_2$ or BPL) rock, followed by Khouribga 75% BPL. Bu Craa was among the major producers in 1975, with export sales reaching 2.7 million tons. However, Bu Craa phosphate rock exports fell drastically to 277,000 tons in 1976 and were derived mostly from production stocked at El Aaiún. Japan was a major customer for

[4] U.S. Embassy, Rabat, Morocco. State Department Airgram A-14, Feb. 7, 1977, 6 pp.
[5] Bulletin Mensuel (Morocco). Mineral Production. Nouvelle Serie No. 89, May 1977, p. 3.
[6] European Chemical News (London). Supply Glut Overhangs Phosphate Industry Despite Market Upturn. V. 30, No. 791, June 17, 1977, pp. 6, 29.

Moroccan phosphate rock as were Brazil and Mexico. European customers, however, were the heaviest buyers and included Belgium, France, Italy, Spain, the United Kingdom, Romania, Yugoslavia, West Germany, and the Netherlands.[7]

Moroccan triple superphosphate exports increased 86% in 1976 over those of 1975. The improvement was attributed to the contributions of the new sulfuric and phosphoric acid facilities at Maroc Chimie II. West Germany was the single largest European buyer with 27,100 tons out of a total of 49,500 tons exported to Europe. Burma was also a large customer with 28,200 tons, as was Brazil with 21,000 tons. Other important buyers included Hungary, Yugoslavia, Bangladesh, Japan, and Australia.

About 75% of the aggregate phosphate rock exports was shipped from Casablanca where the terminal had a storage capacity of 400,000 tons with compartments for four grades of rock: Khouribga 70% to 72% BPL, calcined, 80% to 82% BPL, and 75% to 77% BPL. A modernization and expansion program was continued, making it possible to allow all grades to be loaded simultaneously on vessels. Products associated with the Maroc Chimie fertilizer complex and Youssoufia phosphate mining moved through the port at Safi where work was proceeding on storage and handling facilities for two grades of phosphate rock —the 70% to 72% BPL and the 73% to 75% BPL calcined material. Activity was expected to grow at Safi accompanying increased production from Youssoufia, expansion of the Maroc Chimie fertilizer complex, and construction at Safi of two phosphoric acid/monammonium phosphate (MAP) plants (Maroc Phosphore I and II), the output of which was to be almost entirely exported. The loading capacity of the terminal was to be increased to 10 million tons per year. Construction of a third phosphate shipping terminal in the Doukkala region was also planned.

[7] Phosphorus & Potassium (London). Morocco. No. 87, January–February 1977, p. 12.

Table 1.—Morocco: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Antimony concentrate:			
Gross weight	4,282	2,770	3,723
Metal content	2,141	1,191	1,675
Cobalt concentrate:			
Gross weight	12,518	14,007	7,185
Metal content	1,627	1,821	934
Copper concentrate:			
Gross weight	16,504	17,970	16,380
Metal content	4,951	4,852	[e] 4,914
Iron and steel:			
Iron ore, direct shipping, gross weight	531,287	554,156	342,763
Pig iron [e]	10,000	10,000	10,000
Steel [e]	1,000	1,000	1,000
Lead concentrate:			
Gross weight	141,430	104,327	98,686
Metal content	[r] 86,272	63,639	60,198
Manganese ore, chemical grade	174,781	130,947	117,304
Nickel content of cobalt ore [e]	250	280	143
Silver, mine output, metal content ——thousand troy ounces	3,064	2,894	[e] 2,300
Tin:			
Concentrate:			
Gross weight	4	--	--
Metal content	3	--	--
Smelter, primary [2]	[r] 5	--	--
Zinc concentrate:			
Gross weight	27,354	36,131	29,568
Metal content	[r] 16,412	20,956	17,740
NONMETALS			
Barite	87,778	128,770	129,215
Cement, hydraulic ——thousand tons	[r e] 2,110	2,235	2,324
Clays, crude:			
Bentonite	[r] 2,631	3,051	4,664
Smectite	20,094	23,720	36,768
Other, including fuller's earth	4,343	5,893	3,768
Fertilizer materials, crude, natural: Phosphate rock—thousand tons	19,721	13,548	15,656
Fluorspar	19,050	47,421	51,450
Goethite	24	47	14
Mineral water ——cubic meters	16,874	22,994	28,064
Pyrite and pyrrhotite:			
Gross weight	508,787	203,789	76,242
Sulfur content	152,636	66,231	[e] 22,870
Salt, all types	36,054	60,000	21,430
MINERAL FUELS AND RELATED MATERIALS			
Coal, anthracite ——thousand tons	574	652	702
Fuel briquets [e]	6,000	6,000	6,000
Gas, natural:			
Gross production ——million cubic feet	[r] 2,841	2,501	1,730
Marketed ——do	[r] 2,084	[r e] 2,000	[e] 1,500
Petroleum:			
Crude oil ——thousand 42-gallon barrels	191	171	62
Refinery products:			
Gasoline ——do	2,932	3,123	3,177
Jet fuel ——do	934	983	594
Kerosine ——do	574	754	1,050
Distillate fuel oil ——do	4,884	4,875	5,506
Residual fuel oil ——do	6,214	7,114	7,524
Other ——do	[r] 1,726	1,267	1,499
Refinery fuel and losses ——do	[r] 988	1,157	1,331
Total ——do	[r] 18,252	19,273	20,681

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the commodities listed, Morocco also produces manufactured phosphate fertilizers and a variety of crude construction materials, but available information is inadequate to make reliable estimates of output levels.

[2] Estimate by International Tin Council.

Table 2.—Morocco: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	566	458	Senegal 127; Mali 104; Netherlands 101.
Antimony ore and concentrate	4,084	3,102	Yugoslavia 1,248; United Kingdom 1,013.
Cobalt ore and concentrate	14,547	13,144	France 9,144; People's Republic of China 4,000.
Copper:			
Ore and concentrate	17,586	8,511	Belgium-Luxembourg 4,317; West Germany 2,194.
Metal including alloys, all forms	1,433	354	Spain 191; Netherlands 60; West Germany 26.
Gold waste and sweepings—troy ounces	--	64,301	All to United Kingdom.
Iron and steel:			
Ore and concentrate	10,200	213,920	Poland 55,900; Switzerland 50,330; Czechoslovakia 22,000.
Roasted pyrite	530,297	79,745	East Germany 28,970; West Germany 20,375; Switzerland 15,000.
Metal:			
Scrap	79,800	28,972	Spain 23,968; Italy 3,598.
Ferroalloys	661	297	All to West Germany.
Semimanufactures	1,077	59	Mainly to Senegal.
Lead ore and concentrate	125,905	74,762	West Germany 15,999; Spain 13,321; Belgium-Luxembourg 11,494.
Manganese ore and concentrate	164,940	110,960	United States 24,304; France 22,951; West Germany 14,398.
Silver metal including alloys value, thousands	$82	$278	Switzerland $128; United Kingdom $80; Belgium-Luxembourg $70.
Zinc:			
Ore and concentrate	26,449	26,499	France 12,042; Netherlands 6,817; United Kingdom 2,695.
Oxide	10,293	4,132	All to France.
Metal including alloys, all forms	50	24	Do.
Other:			
Ores and concentrates	31,856	1,290	Mainly to France.
Ash and residue containing nonferrous metals	430	511	All to France.
Oxides, hydroxides, peroxides of metals, n.e.s	8	10	Algeria 5; Libya 4.
NONMETALS			
Barite and witherite	81,686	122,170	United States 76,850; United Kingdom 11,001.
Clays and clay products (including all refractory brick):			
Crude clay, n.e.s.:			
Bentonite	--	1,000	All to Nigeria.
Fire clay	7,472	3,761	NA.
Fuller's earth	22,142	23,216	Spain 17,646; Tunisia 4,373.
Other	(1)	--	
Products:			
Refractory (including nonclay bricks)	5,624	6,168	Iraq 1,983; Lebanon 842; Portugal 745.
Nonrefractory [2]	462	188	NA.
Fertilizer materials:			
Crude phosphatic—thousand tons	18,700	13,110	Poland 1,662; Italy 1,258; Belgium-Luxembourg 1,254.
Manufactured:			
Nitrogenous	--	262	All to Mauritania.
Phosphatic	131,673	87,045	Indonesia 35,125; Hungary 20,000; Brazil 10,500.
Fluorspar	5,500	29,295	Mainly to France.
Gypsum and plasters	181,240	197,956	Nigeria 69,734; Ivory Coast 30,852; Portugal 23,800.
Lime	225	47	Mauritania 20; Gibraltar 10.
Pigments, mineral, including processed iron oxide	1,704	(1)	All to France.
Precious and semiprecious stones, natural and manufactured—value, thousands	$2	$3	France $2.

See footnotes at end of table.

Table 2.—Morocco: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	5,710	4,096	Togo 2,038; Italy 1,792.
Worked	r 164	11	Mainly to United Kingdom.
Gravel and crushed rock	21,221	19,980	NA.
Sand, excluding metal bearing	79,990	16,746	NA.
Sulfur, elemental, all forms	209	955	NA.
Other nonmetals, n.e.s.:			
Crude	--	(1)	All to Botswana.
Slag, dross, similar waste, not metal bearing	38	--	
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	6,163	6,345	Liberia 2,757; Nigeria 2,695.
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades, including briquets	34,135	19,401	Tunisia 16,590.
Petroleum refinery products:			
Gasoline 42-gallon barrels	--	2,123	All to ship stores.
Kerosine do	26,228	21,692	Do.
Distillate fuel oil do	318,006	286,079	Do.
Residual fuel oil do	12,979	112,662	Do.
Lubricants do	3,111	2,658	Mainly to ship stores.
Other:			
Liquefied petroleum gas do	--	510	All to Tunisia.
Unfinished light oils do	106,000	388,254	All to Netherlands.
Other light oils do	414	48	All to ship stores.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	(1)	(1)	Mainly to France.

r Revised. NA Not available.
1 Less than ½ unit.
2 Estimated from square meters.

Table 3.—Morocco: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite and concentrate	930	--
Oxide and hydroxide	1,533	1,114
Metal including alloys, all forms	5,740	5,946
Antimony metal including alloys, all forms	7	5
Arsenic trioxide, pentoxide, acids	23	2
Bismuth metal including alloys, all forms kilograms	177	194
Cadmium metal including alloys, all forms do	776	638
Chromium:		
Oxide and hydroxide	7	1
Metal including alloys, all forms kilograms	10	251
Cobalt:		
Oxide and hydroxide do	28	(1)
Metal including alloys, all forms	30	22
Columbium and tantalum: Tantalum including alloys, all forms do	1	--
Copper:		
Copper sulfate	1	11
Metal including alloys, all forms	5,054	5,746
Gold metal, unworked or partly worked value, thousands	$7	$1,623
Iron and steel metal:		
Scrap	(1)	(1)
Pig iron, including cast iron	2,818	2,250
Sponge iron, powder, shot	106	170
Ferroalloys	395	513
Steel, primary forms	17,023	17,238
Semimanufactures:		
Bars, rods, angles, shapes, sections	202,226	252,311
Universals, plates, sheets	92,312	78,226
Hoop and strip	14,297	10,545
Rails and accessories	11,089	6,431
Wire	14,992	11,293
Tubes, pipes, fittings	21,424	23,384
Castings and forgings, rough	175	141

See footnotes at end of table.

Table 3.—Morocco: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS—Continued			
Lead:			
Ore and concentrate		46,267	3
Oxides		250	224
Metal including alloys:			
Scrap		r(1)	--
Unwrought		2,139	2,288
Semimanufactures		146	86
Lithium:			
Oxides		12	30
Elemental	kilograms	3	--
Magnesium metal including alloys, all forms	do	56	5
Manganese:			
Ore and concentrate		177	360
Oxides		r 45	107
Mercury:			
Oxides	kilograms	17	90
Metal	76-pound flasks	68	48
Molybdenum:			
Oxides	kilograms	13	6
Metal	do	120	20
Nickel:			
Matte, speiss, similar materials		4	--
Metal including alloys:			
Unwrought		12	7
Semimanufactures		677	831
Platinum-group metals including alloys	value	$2,517	$67
Rare-earth metals:			
Compounds, not further described	kilograms	677	228
Metals including alloys	do	142	1
Selenium, elemental	do	302	587
Silver metal including alloys	value, thousands	$6	$100
Tin:			
Oxides		10	(1)
Metal including alloys, all forms		237	243
Titanium:			
Oxides		707	778
Metal including alloys, all forms	kilograms	4	83
Tungsten metal including alloys, all forms	do	r 63	36
Vanadium oxides	do	2	1
Zinc:			
Oxide		323	437
Metal including alloys:			
Scrap	kilograms	10	111
Blue powder		32	52
Unwrought		1,653	1,148
Semimanufactures		r 256	220
Zirconium and hafnium metal including alloys, all forms	kilograms	2	--
Other:			
Ores and concentrates, n.e.s		30	--
Oxides, hydroxides, peroxides of metals, n.e.s	kilograms	333	213
Thorium and uranium compounds, not further described	do	2	23
Metals including alloys, all forms:			
Cermets	do	34	--
Gallium, indium, thallium	do	8	(1)
Metalloids, n.e.s	do	41	45
Pyrophoric alloys	do	382	691
Tellurium and arsenic	do	2	1,050
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		38	44
Grinding and polishing wheels and stones		304	391
Asbestos		6,718	7,160
Barite		2	10
Boron materials:			
Crude natural borates		99	705
Oxide and acid		4	5
Bromine	kilograms	51	277
Cement		12,545	224,419
Chalk		3,687	4,075
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Bentonite	kilograms	75	40,400
Fire clay		11,199	11,202
Fuller's earth	kilograms	7,500	50
Kaolin (china clay)		4,959	1,869
Other		94	145

See footnotes at end of table.

Table 3.—Morocco: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS—Continued		
Clays and clay products (including all refractory brick)—Continued		
Products:		
Refractory (including nonclay bricks)	2,159	3,524
Nonrefractory	2,834	4,294
Cryolite and chiolite	--	100
Diamond:		
Gem, not set or strung ---value	--	$143
Industrial ---do	$1,793	$14
Diatomite and other infusorial earth	352	197
Feldspar	119	27
Fertilizer materials, crude and manufactured:		
Nitrogenous	187,179	155,059
Phosphatic ---kilograms	110	90
Potassic	58,203	71,453
Other, including mixed	35,182	2,453
Fluorspar	20	--
Graphite, natural	9	--
Iodine ---kilograms	357	492
Lime	10,030	10,774
Magnesite	401	132
Mica:		
Crude, including splittings and waste	17	3
Worked, including agglomerated splittings	1	2
Pigments, mineral, n.e.s.:		
Natural, crude	456	246
Iron oxides, processed	559	535
Precious and semiprecious stones:		
Natural ---value	$1	$5,679
Synthetic ---do	$2,478	$5,409
Salt	5	11
Sodium and potassium compounds, n.e.s.:		
Sodium hydroxide	13,885	10,520
Potassium hydroxide	146	142
Peroxides of potassium and sodium ---kilograms	83	119
Stone, sand and gravel:		
Dimension stone	1,151	2,356
Dolomite, chiefly refractory grade	970	1,345
Gravel and crushed rock	242	21
Quartz and quartzite	r 15	(1)
Sand, excluding metal bearing	20,209	22,912
Sulfur:		
Elemental, all forms	77,534	34,859
Sulfur dioxide	32	51
Sulfuric acid	32,690	101,870
Talc, steatite, soapstone, pyrophyllite	1,007	1,070
Other nonmetals, n.e.s.:		
Crude:		
Vermiculite, perlite, chlorite	1	--
Unspecified	318	315
Oxides and hydroxides of magnesium, strontium, barium	3	31
Fluorine	1	--
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	(1)	3
Carbon black and gas carbon	3,925	3,361
Coal and coke, including briquets	27,618	34,018
Hydrogen, helium, rare gases	12	17
Peat, including peat briquets and litter	30	434
Petroleum:		
Crude ---thousand 42-gallon barrels	r 19,650	19,918
Refinery products:		
Gasoline ---do	67	53
Kerosine ---do	16	87
Distillate fuel oil ---do	191	1,393
Residual fuel oil ---do	603	286
Lubricants ---do	213	309
Other:		
Liquefied petroleum gas ---do	867	1,032
White spirit ---do	22	33
Mineral jelly and wax ---do	121	99
Nonlubricating oils, n.e.s ---do	9	3
Asphalt and bitumen ---do	(1)	(1)
Bituminous mixtures, n.e.s ---do	1	1
Unspecified ---do	4	2
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	738	810

r Revised.
1 Less than ½ unit.

COMMODITY REVIEW

METALS

Cobalt.—Production came from the Bou Azzer mine in southern Morocco, owned 55.25% by the French firm Omnium Nord Africain, 35% by the BRPM, 5.5% by the Omnimines group and 4.25% by others. Ore reserves were estimated at 28 million pounds of cobalt metal and total identified resources, at 30 million pounds. In 1976, 7,185 tons of cobalt concentrate was produced, compared with 14,007 tons in 1975.

Copper.—World market prices were barely sufficient to cover production costs at the seven operating copper mines that included the Bou Skour, Ouansimi, and Tazalaght copper mines. New equipment and development plans were being delayed. Copper production fell from 17,970 tons of concentrate in 1975 to 16,380 tons of concentrate in 1976. The production of high copper ore at Assif Imider was planned for 1977, and development of the Bleïda area near Zagora was in progress. The Oumejrane mine, located near Ouarzazate, was expected to produce 1,800 tons per year of cement copper (80% copper) by yearend 1977. Reserves at Oumejrane were estimated at 180,000 tons of 1.8% copper.

Iron Ore.—Production of iron ore by the Société d'Exploitation des Mines de Fer du Rif (SEFERIF) from the mine near Nador decreased significantly to 342,763 tons in 1976, compared with 554,000 tons produced in 1975. Approximately 1,500 workers were employed at the mine. In early 1976, the Société Nationale de Sidérurgie (SONASID) was created and first bids for the steel compex at Nador were issued. The first awards were expected in 1977. Plans called for the plant to begin operation in 1980 or 1981. Plans to establish a $9.3 million iron plant at El Jadida, designed to produce from 100,000 to 120,000 tons per year, were also being made.[8]

Lead and Silver.—The lead smelter at Oued El Heïmer was opened and in 1976 produced 26,379 tons of lead metal and 12,950 kilograms of silver as a byproduct. Consideration was being given to the construction of a new foundry in Meknès with expected production of 65,000 tons per year of lead. Compagnie Minière de Touissit was expected to expand the capacity of its two mines (Beddiane and Oued Mekta) in the Oujda region starting in 1977. The capacity was to be raised from 600 tons to 900 tons per day. Production facilities of the lead-zinc mine at Dra-Sfar near Marrakech were improved in early 1976. Two new veins of major importance were reported in Tétouan Province, and new lead and zinc reserves were also being reported at the Bou Azzer, Touissit, Bou Skour, and Zeïda mines. Exploration was being conducted by the BRPM near Debdou (northeast and south of Oujda), at Tizert, Tirzi, Allous, Assif, Imider, and Naour.

Manganese.—Chemical-grade manganese production for 1976 was 117,304 tons, compared with 131,000 tons for 1975. Production of metallurgical-grade manganese had stopped completely. Most production was derived from the Imini mine operated by the BRPM and Société Anonyme Chérifienne d'Études Minière (SACEM).

Pyrrhotite.—Pyrrhotite was still being produced from the Kettara mine located near Marrakech, but production fell sharply from the 203,789 tons produced in 1975 to 76,242 tons in 1976. The mineral was used as a source of sulfur for the Safi chemical complex.

Uranium.—Three U.S. companies, Gulf Oil Corp., Westinghouse Electric Corp., and the Uranium Recovery Corp., were inquiring into possibilities of uranium recovery from Moroccan phosphate rock. Uranium reserves contained in Moroccan phosphate had been estimated at 18 million tons.[9] Increasing uranium prices of over $40 per pound were offering the phosphate industry a more attractive opportunity to recover uranium as a byproduct of fertilizer manufacture. An independent research organization recently estimated the cost of recovering uranium from phosphoric acid at about $15 per pound by one of two solvent extraction processes. Developed by the Oak Ridge National Laboratory in Oak Ridge, Tenn., these processes both conserve a fuel resource and remove a radioactive fertilizer contaminant.[10] Uranium exploration was also being carried out by the BRPM.

[8] Mining Journal (London). Iron Plant at El Jadida? V. 288, No. 7392, Apr. 22, 1977, p. 309.
[9] Page 15 of work cited in footnote 7.
[10] Chemical Engineering. Recovering Uranium From Wet-Process Phosphoric Acid. V. 84, No. 1, Jan. 3, 1977, pp. 56–57.

Morocco announced its desire to build a nuclear powerplant in order to meet its needs for electric power. Such a project was considered all the more necessary by the Government since a sufficient supply of uranium at a low cost was now being speculated from phosphates.

Zinc.—Zinc oxide production increased at the Zellidja mine in eastern Morocco as a result of a new tailing flotation plant, built by Société des Mines de Zellidja. Tailing retreatment began in early 1976. A Marconaflo system was selected for remining of the tailing pond. A static, or bridge-mounted, caisson was chosen to remine the slimes, which were too soft to support vehicles, and two skid-mounted caissons were used to remine the sand portion. During the first 40 days of operation, each of the skid caissons remined and pumped 65,000 tons of tailing. At the mill, after desliming at 11 microns, about 65% sand and 35% slime were mixed to make a 35% to 38% weight flotation feed.[11] An agreement between Zellidja and a miners cooperative, CADET, was being studied for the construction of a transformation plant for calamine and manufacture of zinc oxide. An agreement was signed in February 1976 between the BRPM and Zellidja for the joint operation of the lead-zinc-gold-pyrite mine at Bou Maadene, as well as for the beneficiation of precious metals at Ksar es Souk and for the recovery of barite at the lead mine in Zeïda.

NONMETALS

Cement.—A $4.1 million contract was signed with the Blue Circle Group of the United Kingdom for supervisory services in connection with building the cement plant at Mediouna, south of Casablanca. The plant was to take 4 years to build and was to have a 1-million-ton-per-year capacity. Construction contracts were to be awarded in 1977. Blue Circle was also involved in work on a similar plant at Oujda. Total cost for plant hardware was estimated at $100 million. Despite a 6% increase in cement production between 1974 and 1975, imports of about 400,000 tons of cement were still needed in the first half of 1976.

In August 1976, a new cement factory in Marrakech owned by Ste. des Ciments de Marrakech S.A. began operation and was expected to produce 500,000 tons annually by 1978. A $66.6 million cement plant was also being built by Blue Circle (Cimenterie de l'Oriental) near Oujda with a 1-million-ton-per-year capacity, and another was planned to be built near Rabat with a 625,000-ton-per-year capacity.

Together with other projected plants, these should cover Morocco's cement needs by 1985. By that date it was projected that Morocco's domestic needs would be 10 million tons of cement annually. Morocco hoped to build a total of 12 more cement plants by 1985. Asmet de Temara S.A., the plant planned for Temara, located south of Rabat, purchased about $26 million in equipment from the United States. A new society, the Société Nationale des Materiaux de Construction (SNMC), was organized during 1976 to work with the private sector in developing a national cement plan.[12]

Fluorspar.—The fluorite mine at El Hammam near Meknès, operated by Société Anonyme d'Entreprises Minières (SAMINE), further increased its production to 51,450 tons, an increase of 8.5% over the 1975 output. Reserves were estimated in 1974 at 5 million tons of 50% CaF_2 ore.

Ore reserves of 665,000 tons were established for the Zrahina fluorite-barite deposit and for the newly discovered Rouif vein by the West German geological mission from the Federal Institute for Geosciences and Natural Resources. The ore contains 34.8% fluorite, 14.1% barite, 1.9% lead, and 60 grams of silver per ton. The BRPM was starting preparations for mining.[13]

Nitrates.—An agreement was concluded between the Moroccan Office for Industrial Development and the consulting Agency for Production and Energy to provide the Office with consultancy services to set up the first ammonium nitrate project in Morocco. The industrial complex will include nitric acid and ammonium nitrate units to manufacture fertilizers and explosives. Operations were expected to start up by 1980.

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[11] World Mining. Fixed and Skid-Mounted Marconaflo Caissons Reclaim Zellidja Tailing. V. 29, No. 12, November 1976, pp. 54–55.

[12] U.S. Embassy, Rabat, Morocco. State Department Airgram A–136, Dec. 29, 1976, 13 pp.

[13] Federal Institute for Geosciences and Natural Resources. Activity Report 1975/1976 (Hannover, West Germany). Morocco. April 1977, p. 49.

Phosphates.—Of the 15.7 million tons of phosphate rock produced in 1976, 8 million tons came from Khouribga strip mining, 4 million tons from underground workings near Khouribga, and 4 million tons from the mining operations at Youssoufia. About 1.5 million tons went into local production of phosphatic chemicals for export.

The three principal phosphate bearing regions of Morocco are the Oulad Abdoun Plateau, the Gantour Plateau, and the Meskala region, which together have reserves estimated at more than 40,000 million tons of crude phosphatic rock.

The Oulad Abdoun Plateau is divided into three sections: Khouribga-Oued Zem, presently under exploitation; Sidi Hajjaj, to the west, where mining will start in 1985; and Sidi Chenane and Kasba Tadla, extending northward along the Atlantic coastline. The Gantour deposits comprise the following sections extending eastward from Youssoufia: Youssoufia, presently exploited; Benguerir, where production was scheduled for 1977; Djenane El Kheil-Ouata; Nzalet El Harareha; and Tassaout. Meskala is located south of Youssoufia between Essaouira and Marrakech and was under study for future exploitation. Production at Meskala was scheduled to start in 1986. A sizable deposit is also located south of the High Atlas range which did not appear to be economically viable at the present time.

The Khouribga deposit extends over 4,000 square kilometers and consists of four individual phosphate beds. Until 1970, mining was limited to Bed I, occurring at depths up to 40 meters; work on Bed II started at the end of that year near Oued Zem. The possibility of exploiting Beds 0 and III were under consideration. Both underground and opencast mining operations were used. There were four underground mines: Recette II, Recette VII, Recette VIII, and Recette IX. Recette IX production was being phased out. The two principal open pit mines were Sidi Daoui and Mera al Arech. A new open pit was located at Recette IV, between Sidi Daoui and Mera al Arech. Beneficiation was carried out at the following facilities: Drying plants at Beni Idir, Khouribga, and Oued Zem; a washing plant at Kerkour Rih; a washing plant for the beneficiation of Bed II ore from Sidi Daoui; and two pilot plants consisting of a calcining unit and a dry-separation unit, each with 400,000-ton-per-year capacity. A new drying plant was under construction at Oued Zem.

At Khouribga, the "Grand Daoui" project was aimed at bringing the aggregate capacity of opencast operations to 10 million tons per year. Construction of a complete handling and storage system was planned. A screening unit and a 15-kilometer conveyor belt system were to bring Sidi Daoui rock to the beneficiation plant at Beni Idir. A 3-million-ton-per-year washing plant and facilities for handling and storage were planned, along with expansion of the Beni Idir complex to 10-million-ton-per-year capacity and a new mining site where an underground operation (Block 8) was to be opened, replacing Block 6.

The Youssoufia deposit, located 70 kilometers east of Safi, was initially brought into production in 1931. Development of the extensive dark phosphate reserves was recently initiated. The project involved a 65-million-ton portion of these reserves which lies beneath the water table. About 70% of the ore mined at Youssoufia was from underground mines. Plans for improvement at Youssoufia during the Office Chérifien des Phosphates (OCP) 1973–77 plan included construction of a new mining site at Recette V, construction of a 10-kilometer conveyor belt line and erection of a handling and storage facility adjoining the drying plant. Development of large-scale projects such as the new mining operations at Benguerir and Sidi Hajjaj were expected to start showing results during the 1978–82 plan. Present Government plans estimate a startup date for Sidi Hajjaj of 1985 with 3 million tons per year, but Benguerir would come onstream first with 8 million tons per year. Plans for Sidi Hajjaj included shipping to the port for processing there. A new port must be built at El Jorf Lasfar as well as a railroad to the port. The ore was to be first processed in saltwater and afterward washed in fresh water.

A new phase of activity was started with OCP's 1973–77 expansion of production at the Safi fertilizer complex from 345,000 tons to 900,000 tons per year. The fertilizer complex at Safi was first brought into production by Maroc Chimie I in June 1965. The production expan-

sion was to be achieved through three main developments, progressing as follows: (1) Addition of the new PK–NPK fertilizer plant Maroc Chimie II, which was commissioned in April 1974 and progressed to 100% installed capacity by 1976; (2) improvement of existing facilities, with production of phosphoric acid increased to 155,000 tons per year and sulfuric acid to 450,000 tons per year; and (3) construction of new facilities, including sulfuric acid, phosphoric acid, and triple superphosphate units. These three new units were scheduled for startup in 1976 with 100% of annual capacity planned for 1978. Maroc Chimie II became operational in early 1976 and was built by the French contractor Spie Batignolles. For Maroc Chimie II, Spie Batignolles built two 1,000-ton-per-day sulfuric acid plants and a 500-ton-per-day phosphoric acid plant. The sulfuric acid plants were using imported brimstone rather than local pyrrhotite.

Consistent with moving toward end-value phosphate rock processing, OCP had also started several large-scale projects involving the erection of a number of phosphoric acid/MAP units in the Maroc Phosphore series. The first unit, Maroc Phosphore I, was located about 10 kilometers from Safi near the Maroc Chimie complex. The plant included a 4,500-ton-per-day sulfuric acid unit, a 1,500-ton-per-day phosphoric acid unit, and a MAP unit with an annual 415,000-ton product capacity. Startup of the first stage was scheduled for 1975, with the second stage to be brought into production by late 1976. Maroc Phosphore I was built by a consortium of Uhde France, Polimex of Poland, and Siemens A.G. of West Germany, with Nissan technology, and was scheduled to process 1.65 million tons of phosphates supplied from Youssoufia. About 33% of the phosphoric acid was used for MAP production, with the remainder going for export. Heurtey Industries and Uhde France were to build the Maroc Phosphore II phosphoric acid complex planned for Safi, including three 1,700-ton-per-day sulfuric acid plants with offsite storage facilities and three 500-ton-per-day phosphoric acid plants.

Morocco further improved its potential as a world producer with acquisition of 65% of Spanish Sahara's Bu Craa deposits in 1976. Spain's Government-owned holding company Instituto Nacional de Industria (INI) retained the remaining 35%. Spain withdrew from the Sahara on February 28, 1976, and Morocco and Mauritania were assigned administration of the territory under a bilateral agreement that was signed in April. Under the terms of the agreement, the area was split geographically, giving Morocco administration of the Bu Craa mines, but adding the provision that Mauritania should also benefit from the phosphate sales. With acquisition of a majority holding in Fosfatos de Bu Craa (Fosbucraa), the company headquarters was transferred to Rabat and the sales organization was linked to the OCP. A consortium of small banks was loaning $20 million to Fosbucraa to cover costs of repair to damaged facilities and get the mine back into full operation.

Production of phosphate rock from Bu Craa was at a standstill for much of the year. Rock transportation by conveyor belt to port El Aaiún was paralyzed much of the time. The conveyor belt, extending in sections over 100 kilometers, has often been called the world's longest conveyor.[14] At yearend, both the calcination plant and powerplant were closed. Plans were being discussed for rock transport by trucks under military guard. Over 300 workers employed at Bu Craa were laid off, and in an effort to alleviate excessive unrest, the OCP offered work at its facilities in Morocco.

Potash.—In early 1976, studies were conducted on the Khemisset potash deposits with respect to possible production of potassium chloride and potassium sulfate.

Salt.—New reserve estimates indicate 3 billion tons of rock salt in the deposits located near Mohammedia. Equipment was installed during 1976 for the expected initial production of 900,000 tons annually in 1978.[15] Plans were also underway to use the cavities left by salt extraction for the storage of imported crude oil. A chemical complex was planned to be developed concurrently that would allow production of chlorine, caustic soda, polyvinyl chloride, and soda ash.

[14] Canadian Mining Journal. World's Longest Conveyor Stretches 100 Kilometers Over Sahara. V. 98, No. 9, September 1977, pp. 63–64.

[15] To the Point International (Brussels). Bigger Salt Yield. V. 4, No. 19, May 2, 1977, p. 35.

MINERAL FUELS

Coal.—A new open pit coal mine was opened at Jerada, where the BRPM was studying the possibility of coking anthracite coal. The only sizable increase in mineral production recorded for 1976 was in anthracite mining at Jerada by the Moroccan Government. Output increased from 652,000 tons in 1975 to 701,756 tons in 1976.

Oil Shale.—The West German firm Kloeckner was evaluating oil shale deposits at Timhadit in the Middle Atlas. The BRPM was also conducting research on bituminous shale at Timhadit and Tarfaya in conjunction with the Oil Shale Corp. (OSCO) and Union Oil Co. of the United States. The existence of several billion tons of proved reserves was verified by drilling. Reserves of 1,800 million tons of shale with a potential oil yield of 10% were indicated at Timhadit from the initial drilling program.[16] Recent oil shale studies released by OSCO, however, revealed reserves estimated at 10 billion tons at Timhadit, with an oil content of 74 liters per ton. Oil content at Tarfaya proved to be variable, from 8 to 72 liters per ton, with reserves as yet undetermined. The U.S.S.R. was also performing tests and reportedly established that the shales can be burned directly as a low-yield fuel, as with Baltic deposits.[17]

Petroleum.—The OCP and Abu Dhabi National Oil Company commissioned Badger Co. Inc. of the United States to make a feasibility study for a joint fertilizer and oil refining complex to be located at El Jorf Lasfar, near El Jadida.

Phillips Petroleum Co. (operator), Getty Oil Co., and Agip S.p.A. (Italy) took equal shares in two offshore exploration areas that covered 10,000 square kilometers between Agadir and Essaouira. The blocks extend from about 20 to 120 kilometers off the coast in depths up to 2,000 meters. Title to the blocks, which were known as Cap Sim Profond and Cap Tafelney Profond, was held by the BRPM.[18]

An accord was signed between Phillips Petroleum, British Petroleum Co. Ltd., and the BRPM for exploration and exploitation of oil in an area covering about 35,000 square kilometers in the Saharan Province of Boujdour.[19]

The BRPM completed Toukimt 1, an oil and gas discovery at 11,483 feet. Toukimt 2 and Toukimt 3 were also started, but no results were reported. Sun Oil Co. abandoned the offshore Ifni Marine 1 at 6,500 feet. In total, seven wells were drilled in 1976; six were dry, but two of the seven were still drilling at yearend. A total of 78,000 feet were drilled, compared with 52,993 feet for 1975.

Exxon Corp., Phillips Petroleum, and the BRPM did geophysical surveys, with 1,100 line-miles shot by the BRPM onshore, 300 line-miles shot by Exxon offshore, and 1,260 line-miles shot by Phillips offshore. Exxon relinquished three shelf permits and six deepwater permits.

Morocco's crude oil production was derived from seven small fields that were discovered between 1957 and 1961, plus Sidi Rhalem, discovered in 1961. Gas production increased from 6.6 billion cubic feet per day in 1975 to 7.5 billion cubic feet per day in 1976. The increase was derived from the Ksiri gasfield that began producing in 1976.[20]

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[16] Nicod, M. A. Petroleum Developments in North Africa in 1975. AAPG Bull., 1975, p. 1795.
[17] U.S. Embassy, Rabat, Morocco. State Department Airgram A-52, May 25, 1977, p. 4.
[18] Petroleum Economist (London). Morocco. V. 43, No. 7, July 1976, p. 281.
[19] Industries et Travaux D'Outre-mer (Paris). Morocco. No. 285, April 1977, p. 569.
[20] World Oil. Morocco. V. 185, No. 3, pp. 151–152.

The Mineral Industry of Mozambique

By David E. Morse [1]

The mineral industry of Mozambique was a minor contributor to the economy of the young nation in 1976. Mineral production as well as activity in most sectors of the economy declined during the year. In March, the Government closed the border with Southern Rhodesia which had a pernicious effect on the already struggling economy. Mozambique had previously earned significant revenues from the transport of goods to and from Rhodesia because 40% of Rhodesian imports and exports had been shipped through the ports of Maputo and Beira, Mozambique. In addition, Mozambique experienced a loss in transient revenues derived from goods destined for Botswana and Zambia by way of Rhodesia. An estimated 75,000 Mozambique nationals were isolated in Rhodesia at the time of the border closure, resulting in an attendant loss of remittance revenue. Other important factors in the country's economic decline were the continued exodus of European managers and technically skilled personnel, the restructuring of the society to meet the new framework of national goals, and the low labor productivity. The Government planned to return to the 1973 production levels by 1980.

Throughout 1976, Mozambique continued to supply a large force of laborers to South African mines, although at a much reduced rate from that of 1975 when 115,000 workers were recruited. The return of some 90,000 workers from the Republic of South Africa and the smaller number of recruits caused the Mozambique workforce employed in the Republic of South Africa to drop to an estimated 65,000 laborers. The work force reduction resulted in a 34% decrease in remittances to the Mozambique Government from the Republic of South Africa, which further reduced foreign exchange earnings during 1976.

The 1976 balance of trade deficit swelled by $75 million[2] to an estimated $275 million despite significant efforts by the Government to restrict imports. The increased cost of imported manufactured goods, crude oil, and petroleum products and the decline in agricultural exports were the prime contributors to the larger trade deficit.

The Cabora-Bassa Gorge hydroelectric project neared maturity in 1976. The 163-meter-high dam created a 250-kilometer-long, 30-kilometer-wide lake in the Zambezi Valley of the Tete District. The third 450-megawatt generator in the south power station came online in 1976. A 1,400-kilometer, dual 530-kilovolt direct current transmission line from Songo, Tete District, to Irene near Pretoria, Republic of South Africa, was completed during the year. Two additional 450-megawatt generators were to be in operation in the south power station by yearend 1979.

During 1976, the U.S.S.R. sent a team of geologists and mining experts to Mozambique to engage in mineral prospecting for bauxite, iron ore, and manganese. The Government stated its willingness to receive foreign investment in mineral activities, but has not promulgated information on its mineral policies.

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[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Mozambique escudos (ME) to U.S. dollars at the rate of ME1 = US$0.0331.

Table 1.—Mozambique: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum, bauxite, gross weight	r 5,364	2,175	e 2,000
Beryllium, beryl concentrate, gross weight	r 11	9	e 10
Bismuth, mine output, metal content ---kilograms--	1,000	r e 1,000	--
Columbium and tantalum, ore and concentrate, gross weight:			
Microlite	r 62	44	56
Tantalite	r 46	46	30
Copper, mine output of salable ore and concentrate:	r 3,218	3,212	--
Gross weight	r 805	803	e 700
Metal content ---troy ounces--	20	20	20
Gold [e]	2	2	2
Tungsten, mine output, metal content (scheelite) [e]			
NONMETALS			
Abrasives, natural, unspecified	435	NA	NA
Asbestos	190	(2)	--
Cement, hydraulic ---thousand tons--	465	281	217
Clays:	r 8,365	5,802	2,298
Bentonite (including montmorillonite)			
Kaolin (including china clay):	r 305	454	e 450
Crude	171	r e 200	e 200
Washed	840	e 850	e 850
Feldspar	r 34,436	23,652	31,300
Fertilizer materials, manufactured, all types			
Gem and ornamental stones: ---kilograms--	4,200	--	NA
Amazonite ---do---	4	--	NA
Aquamarine ---do---	55	13	32
Beryl crystal ---do---	14,426	NA	2,360
Garnet ---do---	16	NA	NA
Morganite ---do---	190,100	NA	NA
Obsidian ---do---	16,000	NA	NA
Topaz ---do---	4,248	NA	25
Tourmaline	r 843,958	535,867	e 500,000
Lime (hydraulic)			
Lithium minerals:	730	e 730	e 730
Lepidolite	25	e 25	e 25
Spodumene	852	900	e 900
Mica, mainly scrap			
Salt:	r 30,862	31,301	e 28,000
Marine	20	20	20
Rock [e]			
Stone and sand: ---thousand tons--	682	e 600	NA
Limestone ---do---	456	107	NA
Granite and other quarry stone ---do---	e 800	NA	NA
Sand	23,352	8,548	15,300
Sulfur, sulfuric acid			
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous ---thousand tons--	426	575	553
Petroleum refinery products: ---thousand 42-gallon barrels--	601	536	e 473
Gasoline ---do---	127	241	e 195
Kerosine ---do---	68	61	e 56
Jet fuel ---do---	947	704	e 613
Distillate fuel oil ---do---	1,607	1,113	e 1,003
Residual fuel oil ---do---			
Other: ---do---	94	179	e 167
Liquefied petroleum gas ---do---	80		
Asphalt ---do---	388	312	e 278
Refinery fuel and losses ---do---	3,912	3,146	2,785
Total			

e Estimate. p Preliminary. r Revised. NA Not available.

[1] In addition to the commodities listed, other crude mineral commodities may be produced, particularly for local use, but data are not available and information is inadequate to make reliable estimates of output levels.

[2] Revised to none.

Table 2.—Mozambique: Exports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Beryllium ore and concentrate	3	NA
Columbium and tantalum minerals	r 198	140
Copper metal including alloys	r 73	469
Iron and steel:		
Scrap	9,767	8,908
Semimanufactures	1,525	NA
NONMETALS		
Asbestos	424	1,148
Cement	r 70,796	30,972
Clays and clay products:		
Crude clays, bentonite	4,327	1,430
Nonrefractory, bricks	6,917	NA
Fertilizers, nitrogenous	2,437	NA
Gem stones, except diamond ---kilograms	r 1,200	30,700
Salt	5,125	8,577
Stone, dimension	396	--
Sulfur, sulfuric acid	3,478	NA
MINERAL FUELS AND RELATED MATERIALS		
Coal	98,112	236,608
Petroleum refinery products:		
Gasoline ---thousand 42-gallon barrels	r 153	196
Jet fuel and kerosine ---do---	r 88	50
Distillate fuel oil ---do---	r 277	321
Residual fuel oil ---do---	r 1,121	627
Lubricants ---do---	1	--

r Revised. NA Not available.

Table 3.—Mozambique: Imports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, all forms	903	634
Copper metal including alloys, all forms	r 294	289
Iron and steel semimanufactures	r 74,060	30,021
NONMETALS		
Cement, hydraulic	23,221	2,831
Clays and clay products:		
Refractory	3,002	756
Nonrefractory	2,894	1,618
Fertilizer materials, manufactured	12,737	5,344
Gypsum	15,390	8,937
Sodium and potassium compounds, caustic soda	5,043	4,022
Sulfur, elemental, all forms	19,092	NA
MINERAL FUELS AND RELATED MATERIALS		
Coal, anthracite and bituminous	235,435	178,812
Petroleum:		
Crude ---thousand 42-gallon barrels	r 1,874	2,446
Refinery products:		
Gasoline ---do---	90	124
Kerosine ---do---	72	136
Distillate and residual fuel oil ---do---	r 1,188	953
Lubricants ---do---	65	137
Bitumen and petroleum coke ---do---	--	7

r Revised. NA Not available.

COMMODITY REVIEW

METALS

Bauxite.—The Alumen mine near Manica was the only operating bauxite mine in Mozambique during 1976. Electric power had been supplied to this area from Southern Rhodesia, and the effect of the border closure on mine output was not known. Reserves at the mine were estimated at 60 million tons of bauxite averaging 44% Al_2O_3.

Copper.—The only copper mine in Mozambique was the Edmundian mine between Manica and the Rhodesian border. The mine had been controlled by a Rhodesian firm but its fate was unknown following the closure of the border. The Chidua copper deposit in the Tete District has been studied and was considered for economic development.

Iron.—There were numerous iron ore deposits in Mozambique but they were not being exploited in 1976. None of the known deposits have reserves in excess of 20 million tons of ore.

Mineral Sands.—Titanium mineral and zircon bearing sands were contained in coastal beach dunes and in offshore deposits between Maganja da Costa and Moma along the north-central coast of Mozambique. Underwater deposits near Pebane containing 30 million tons of ilmenite, 3 million tons of zircon, and 2 million tons of rutile have been investigated by the Preussag A.G. exploration group of West Germany.

NONMETALS

Asbestos.—In 1976, Minas Gerais de Mozambique Lda. was scheduled to begin anthophyllite (grades 3 to 7) production at Mavita, 50 kilometers southwest of Vila Pery. Proven ore reserves were 250,000 tons and 1 million tons was listed as probable ore.

Cement.—The aggregate capacity of Mozambique's cement plants at Matola, Dondo, and Nacala was 990,000 tons in 1976. The civil construction industry, which was nearly paralyzed by the exodus of Portuguese settlers, was severely influenced by the nationalization of all rental property in early 1976. This action had a concomitant effect on the cement industry. Cement output was also constricted by decreased worker productivity and the lack of spare parts caused by the import restrictions.

Fluorspar.—Fluorite deposits have been reported at Djanguire and Lupata in Tete and at Canxixe and Dejalire in Vila Pery. The Djanguire deposit contained an estimated 600,000 tons of ore averaging 62% fluorite and 60 million tons averaging 20% fluorite. None of the known fluorite deposits were being exploited during 1976.

Other Nonmetals.—Small-scale mines extracted a variety of semiprecious stones and columbite-tantalite ore from the pegmatites of the Moçambique, Niassa, and Zambézia Districts. Quality garnets were mined near Nova Freixo, Niassa District.

MINERAL FUELS

Coal.—Companhia Carbonifera de Moçambique S.A.R.L. (CCM) continued to operate the largest mining operation in Mozambique. CCM produced coal from the Moatize mine 30 kilometers east of Tete, Tete District. Proven reserves in the company's 31-square-kilometer concession area were 400 million tons. In September a methane gas/coal dust explosion caused the death of 95 persons and it was subsequently decided to seal the No. 6 shaft. Production was not severely curtailed as the company continued underground operations through two other portals. Two West German companies contracted to complete a feasibility study to determine the viability of establishing a 2-million-ton-per-year open cast operation in a section of CCM's coal concessions. The results of the study were expected in early 1977. Other coal deposits in the Tete District near Chicoa and Mucanha were studied and were to be exploited to produce coal for exports.

Natural Gas.—Natural gas was discovered at Temane and Pande in eastern Inhambane and at Búzi in the Beira District. Total reserves were estimated at 121 billion cubic meters of natural gas by the Geologic Survey in 1974. The natural gasfields of eastern Mozambique remained unexploited throughout 1976.

Petroleum.—No petroleum exploration activity took place in Mozambique during 1976. The petroleum refinery near Maputo continued to operate well below rated capacity because of import restrictions. In July, Iraq agreed to donate crude oil valued at $1 million to Mozambique.

The Mineral Industry of the Netherlands

By William F. Keyes [1]

The Dutch economy made a hesitant recovery in 1976 from the previous year's recession, particularly toward the end of the year. A real growth of 4% brought the gross national product (GNP) to $89.6 billion,[2] and the index of industrial production (1970=100) increased from 115 in 1975 to 124 in 1976. Unemployment declined from 6.0% in 1975 to 5.7% in 1976.[3] Inflation continued at about 8%, but a good performance in international markets, led by higher gas sales, induced an appreciation in the value of the guilder.

Steel production rose about 8% to 5.2 million tons, but remained well below the capacity of 7.3 million tons. Natural gas production, the largest extractive industry, increased 7% largely in response to increased export demand, but reserves declined, leading to concern for the future. The petroleum-refining industry improved somewhat in 1976, but still operated well below capacity. Operations in the other two primary minerals industries, production of aluminum and zinc, were close to normal. Other minerals-related events during the year were the completion of a third basic oxygen furnace by the major steel producer and development of knowledge of a new oil discovery in the North Sea.

Notwithstanding, concern over structural unemployment, low profitability, low capital investment, and continuing inflation led the Government to announce a "one-percent" policy, under which a ceiling of one percentage point per year would be imposed on the growth of the collective burden borne by the economy (taxes, social insurance, and nontax revenue). Export sales of natural gas were excluded from this policy since the Government was determined that long term contracts entered into when energy problems were of less concern should be revised to reflect the greater value of the product compared with imported petroleum.

PRODUCTION

Production of metals and minerals showed little change in 1976 over that of the previous year, with both gains and losses being recorded, although most industries still worked below capacity. The only industry with a sizable increase in production was natural gas, with an increase of 7%. However, there was doubt as to whether the country's reserves could continue to support this growth in production.

Major producers of minerals and metals in the Netherlands are listed in the following tabulation:

[1] Supervisory physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Netherlands guilders (Hfl) to U.S. dollars at the rate of Hfl2.60=US$1.00.

[3] The method of calculating unemployment was revised in February 1976.

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	Aluminium Delfzijl N.V., smelter at Delfzijl, Billiton-Shell	35
Do	Péchiney-Nederland N.V., smelter at Vlissingen, Péchiney Ugine Kuhlmann, France	65
Cement	Eerste Nederlandse Cement Industrie (ENCI) N.V., plant at Maastricht	55
Do	Cementfabriek IJmuiden B.V., plant at IJmuiden	30
Do	Cementfabriek Rozenburg B.V., plant at Rozenburg	15
Iron and steel	Hoogovens IJmuiden B.V., plant at IJmuiden, ESTEL N.V.	90
Natural gas	Nederlandse Aardolie Maatschappij B.V., fields at Assen and offshore	95
Petroleum, refined	Shell Nederland Raffinaderij B.V., refinery at Rotterdam	25
Do	BP Raffinaderij Nederland N.V., refinery near Rotterdam	25
Do	Esso Nederland B.V., refinery near Rotterdam	16
Do	Chevron Petroleum Maatschappij (Nederland) B.V., refinery near Rotterdam	15
Zinc and lead	N.V. Kempensche Zink-Maatschappij, plant at Budel, Billiton, Australian Mining and Smelting	100

Table 1.—Netherlands: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity[1]		1974	1975	1976
METALS				
Aluminum metal, primary	tons	251,711	260,833	255,504
Cadmium metal	do	95	380	398
Iron and steel:				
Sintered ore (from imported ore)		3,280	2,842	2,666
Pig iron including blast furnace ferroalloys		4,804	3,970	4,265
Crude steel		5,840	4,822	5,188
Semimanufactures		5,169	4,051	4,530
Lead metal, primary	tons	26,410	23,940	21,890
Zinc metal, primary	do	78,169	123,942	123,200
NONMETALS				
Cement		4,088	3,706	3,481
Fertilizer materials, manufactured:				
Nitrogenous, nitrogen content		1,160	1,214	1,071
Phosphatic, phosphorus pentoxide content		346	259	233
Salt, all types		3,387	2,690	3,026
Sand, industrial		23,514	21,600	24,400
Sulfur:				
Elemental, byproduct		r 86	107	105
Sulfuric acid (100% H_2SO_4)		657	484	531
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	tons	101,000	79,600	90,000
Coal, anthracite and bituminous		r 801	--	--
Coke		2,687	2,680	2,813
Gas:				
Manufactured, all types[2]	million cubic feet	104,890	89,255	89,810
Natural:				
Gross production	do	2,956,707	3,208,428	3,436,171
Marketed	do	2,949,750	3,193,278	3,426,848
Petroleum:				
Crude oil	thousand 42-gallon barrels	10,227	9,672	9,345
Refinery products:				
Gasoline:				
Aviation	do	1,593	1,157	1,228
Motor	do	48,416	54,774	59,118
Jet fuel	do	23,264	21,952	23,888
Kerosine	do	5,929	4,611	5,193
Distillate fuel oil	do	129,595	120,375	134,496
Residual fuel oil	do	154,319	132,088	144,395
Lubricants	do	4,032	2,786	6,601
Bitumen	do	6,078	6,193	6,260
Liquefied petroleum gas	do	9,582	10,428	12,203
Other	do	65,927	44,270	71,409
Refinery fuel and losses	do	30,176	24,355	25,592
Total	do	478,911	422,989	490,383

[1] In addition to the commodities listed, the Netherlands presumably produces a variety of crude construction materials (clays, stone, and gravel), but production is not reported and available information is inadequate to make reliable estimates of output levels.

[2] Coke oven and blast furnace gas only.

TRADE

The Netherlands imported crude petroleum largely from Iran and Nigeria, along with lesser amounts of refined products. Exports of crude petroleum were nominal, but the Rotterdam refining industry sold products to neighboring countries and for ships' bunkers. The chief metallic ores and concentrates imported were alumina from Surinam and France for the Delfzijl and Vlissingen smelters, and zinc concentrates, mostly from Australia and West Germany, for the Budel smelter. Much of these imports was used in the Dutch metal industries, but there were important exports of aluminum to France and of zinc to the United Kingdom.

The value of the chief mineral products traded by the Netherlands in 1975 is given in the following tabulation:

Commodity	Value (millions)			
	Imports	Percent	Exports	Percent
Petroleum and petroleum products	$5,660	18.7	$3,843	12.7
Iron and steel	1,298	4.3	1,051	3.5
Nonferrous metals	613	2.0	570	1.9
Metal ores and scrap	386	1.3	--	--
Natural fertilizers and crude minerals	355	1.2	460	1.5
Natural and manufactured gas	--	--	1,271	4.2
Total trade	30,240	100.0	30,188	100.0

Table 2.—Netherlands: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite	4,521	2,652	Sweden 1,168.
Oxide and hydroxide	27,413	25,816	West Germany 7,724; Japan 2,998; France 2,729; Sweden 2,587; Italy 2,471.
Metal including alloys:			
Scrap	37,925	32,980	West Germany 22,077; Belgium-Luxembourg 4,653.
Unwrought	293,982	264,181	Belgium-Luxembourg 72,388; France 69,241; West Germany 69,021.
Semimanufactures	79,692	63,352	West Germany 27,924.
Antimony metal including alloys, all forms	38	60	Belgium-Luxembourg 43; Norway 10.
Arsenic oxides and acids	NA	163	West Germany 91; Italy 42; Morocco 30.
Bismuth metal including alloys, all forms	47	41	France 14; Canada 10; West Germany 5.
Cadmium metal including alloys, all forms	98	341	United Kingdom 94; France 82; United States 69; Belgium-Luxembourg 40.
Chromium:			
Chromite	35,035	27,289	West Germany 15,680; France 5,278.
Oxide and hydroxide	150	282	Italy 131; West Germany 112.
Cobalt:			
Oxide and hydroxide	10	10	All to West Germany.
Metal including alloys, all forms	142	117	Sweden 31; United Kingdom 28; United States 22; Austria 21.
Columbium and tantalum: Tantalum including alloys, all forms	2	1	Mainly to United States.
Copper metal including alloys:			
Scrap	37,514	25,111	West Germany 12,406; Belgium-Luxembourg 8,659.
Unwrought	22,584	14,670	France 5,833; United States 4,318; West Germany 2,311.
Semimanufactures	33,318	32,799	West Germany 11,864; United States 5,412.
Germanium metal including alloys, all forms	1	1	All to United States.
Gold [1] thousand troy ounces	428	552	France 238; Switzerland 195.

See footnotes at end of table.

Table 2.—Netherlands: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	196	96	West Germany 93.
Metal:			
Scrap ---do---	1,374	1,096	West Germany 810; Belgium-Luxembourg 160; Spain 90.
Pig iron and ferroalloys [2] ---do---	64	14	West Germany 11.
Steel, primary ---do---	1,733	1,484	West Germany 471; Belgium-Luxembourg 233; United States 190; United Kingdom 169.
Semimanufactures:			
Bars, rods, angles, shapes, sections ---do---	721	522	Belgium-Luxembourg 125; West Germany 103; United Kingdom 76.
Universals, plates, sheets ---do---	1,900	1,475	United Kingdom 347; United States 205; West Germany 193; Belgium-Luxembourg 173.
Hoop and strip ---do---	163	84	West Germany 46; Belgium-Luxembourg 9.
Rails and accessories ---do---	45	30	West Germany 8; Thailand 5; Switzerland 5; Malaysia 4; Italy 3.
Wire ---do---	45	40	France 11; West Germany 11; Belgium-Luxembourg 7.
Tubes, pipes, fittings ---do---	652	444	United Kingdom 125; Belgium-Luxembourg 102; West Germany 90.
Castings and forgings, rough do---	9	9	West Germany 7.
Lead:			
Oxides	210	165	Belgium-Luxembourg 74; Curaçao 40; West Germany 27.
Metal:			
Scrap	21,602	11,611	Belgium-Luxembourg 3,543; France 3,532; West Germany 2,352.
Unwrought	20,376	24,594	West Germany 5,859; Poland 5,806; France 3,559; United Kingdom 2,939.
Semimanufactures	2,389	2,113	Belgium-Luxembourg 787; Norway 508; United Kingdom 239.
Magnesium metal including alloys:			
Scrap	1,495	1,364	West Germany 928; United States 167; Belgium-Luxembourg 166.
Unwrought and semimanufactures	1,982	2,408	West Germany 1,859.
Manganese:			
Ore and concentrate	33,553	26,030	France 5,584; West Germany 4,587.
Oxide	94	102	Italy 50; Belgium-Luxembourg 19.
Mercury ---76-pound flasks---	152	1,247	United Kingdom 522; West Germany 377.
Molybdenum metal including alloys, all forms	75	191	West Germany 103; Belgium-Luxembourg 42.
Nickel:			
Ore and concentrate	NA	324	Mainly to West Germany.
Matte, speiss, similar materials	642	324	Do.
Oxide and hydroxide	364	38	West Germany 10; Belgium-Luxembourg 10; Hong Kong 8; Bulgaria 6; Hungary 4.
Metal including alloys:			
Scrap	1,835	2,461	West Germany 843; Spain 720; United Kingdom 333.
Unwrought	10,195	3,713	Sweden 808; West Germany 547; France 444.
Semimanufactures		4,788	Sweden 4,170.
Platinum-group metals, all forms troy ounces	27,971	5,691	West Germany 482; United States 386.
Selenium, elemental	7	4	Poland 3.
Silver metal including alloys, all forms thousand troy ounces	4,477	12	NA.
Tellurium, elemental, and arsenic	16	30	France 6; Italy 5; United Kingdom 5; Bulgaria 4.

See footnotes at end of table.

Table 2.—Netherlands: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Tin:			
Oxide	94	9	Belgium-Luxembourg 5; France 3.
Metal including alloys:			
Scrap	629	434	West Germany 194; Denmark 136; United Kingdom 62.
Unwrought	1,707	1,135	West Germany 392; Belgium-Luxembourg 332; United Kingdom 246.
Semimanufactures	458	523	West Germany 264; Belgium-Luxembourg 170.
Titanium dioxide	22,580	18,927	West Germany 4,588; France 3,352; Italy 2,814; Belgium-Luxembourg 2,706.
Tungsten:			
Ore and concentrate	939	1,254	West Germany 399; U.S.S.R. 398; United Kingdom 223; Poland 125.
Metal including alloys, all forms	295	192	Belgium-Luxembourg 142; West Germany 23.
Zinc:			
Ore and concentrate	57,985	28,875	Belgium-Luxembourg 22,989; West Germany 5,886.
Oxide	12,139	7,456	Belgium-Luxembourg 1,644; West Germany 1,207.
Metal including alloys:			
Scrap	12,233	7,457	France 4,241; Belgium-Luxembourg 1,602; West Germany 839.
Dust (blue powder)	1,106	1,230	NA.
Unwrought	68,003	90,247	United Kingdom 41,376; United States 14,763; France 11,765; West Germany 10,758.
Semimanufactures	608	2,419	West Germany 1,867; Belgium-Luxembourg 388.
Other:			
Ore and concentrate, n.e.s	53,354	74,247	West Germany 27,411; France 15,300; United Kingdom 8,186.
Base metals including alloys, all forms, n.e.s	1,129	1,767	West Germany 1,071; United Kingdom 189.
Ash and residue containing nonferrous metals:			
Aluminum [3]	8,172	6,186	West Germany 3,859; France 2,327.
Lead	2,805	5,624	Belgium-Luxembourg 3,478; United Kingdom 912; West Germany 641.
Zinc	12,084	9,747	West Germany 4,736; Belgium-Luxembourg 2,839; France 1,765.
Other [3]	6,729	11,384	West Germany 6,167; United Kingdom 1,804; Belgium-Luxembourg 1,446; Sweden 1,205.
Oxides, hydroxides, peroxides of metals, n.e.s	29	12	United States 10.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum	6,258	5,062	West Germany 1,575.
Dust and powder of precious and semi-precious stones including diamond thousand carats	1,794	2,390	West Germany 543; France 418; Belgium-Luxembourg 401; Italy 370.
Grinding and polishing stones	2,348	2,569	West Germany 770; United Kingdom 496; Belgium-Luxembourg 267.
Asbestos	220	189	Belgium-Luxembourg 60.
Barite and witherite	73,724	81,568	United Kingdom 37,053; Norway 22,995; West Germany 9,953.
Borates, crude, natural	343,650	336,722	West Germany 72,781; France 63,433; United Kingdom 50,256; Belgium-Luxembourg 33,960.
Cement	253,925	205,967	West Germany 80,269; Nigeria 58,403; Belgium-Luxembourg 41,985.

See footnotes at end of table.

Table 2.—Netherlands: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Chalk	30,801	27,193	Belgium-Luxembourg 26,513.
Clays and clay products:			
Crude clays:			
Kaolin	64,825	52,192	Belgium-Luxembourg 50,304.
Refractory	3,622	3,370	Belgium-Luxembourg 1,352; United Kingdom 1,054.
Other including bentonite	138,834	125,338	West Germany 71,293; Belgium-Luxembourg 37,665.
Clay products:			
Refractory including nonclay bricks	24,382	32,676	West Germany 8,944; France 2,844; Italy 2,416.
Nonrefractory thousand tons	678	671	West Germany 458; Belgium-Luxembourg 188.
Diamond, not set or strung, except dust and powder thousand carats	1,997	1,478	United Kingdom 385; Belgium-Luxembourg 266; West Germany 225; United States 159.
Diatomite and other infusorial earth	191	222	West Germany 129; Belgium-Luxembourg 57.
Feldspar, fluorspar, leucite	623	421	Belgium-Luxembourg 316.
Fertilizer materials:			
Crude:			
Nitrogenous (nitrogen content)	2,806	NA	
Phosphatic	81,970	25,998	West Germany 13,484; Belgium-Luxembourg 10,149.
Other	34,894	44,891	Belgium-Luxembourg 27,726; West Germany 9,673; France 7,080.
Manufactured:			
Nitrogenous thousand tons	2,454	2,031	United States 304; West Germany 201.
Phosphatic (including Thomas slag) do	346	216	France 44; West Germany 30.
Potassic (K_2O content)	2,761	2,773	United Kingdom 1,785; Belgium-Luxembourg 443.
Other including mixed thousand tons	977	731	France 231.
Ammonia, anhydrous do	709	678	Belgium-Luxembourg 224; Spain 90; United Kingdom 80; Ireland 69.
Graphite, natural	327	217	West Germany 158; Belgium-Luxembourg 25.
Gypsum and plasters	3,479	11,081	Belgium-Luxembourg 10,814.
Lime	r 2,265	3,834	NA.
Magnesite	34,785	39,086	West Germany 15,108; Italy 4,996.
Mica	601	1,143	Muscat 500; West Germany 144; Nigeria 143.
Pigments, mineral, including processed iron oxides	2,476	2,301	West Germany 944; United Kingdom 386; Belgium-Luxembourg 356; Indonesia 273.
Precious and semiprecious stones, except diamond kilograms	21,190	25,050	Hong Kong 20,000.
Salt thousand tons	2,240	1,897	West Germany 557; Sweden 514; Belgium-Luxembourg 406; Finland 255.
Stone, sand and gravel:			
Dimension stone:			
Unworked and partly worked	4,254	19,987	Belgium-Luxembourg 16,547; West Germany 3,071.
Worked	7,389	9,261	West Germany 4,457; Belgium-Luxembourg 3,090.
Dolomite	12,201	19,147	Belgium-Luxembourg 12,748; West Germany 5,812.
Gravel and crushed stone thousand tons	4,296	333	Belgium-Luxembourg 164; West Germany 162.
Limestone	1,828	2,554	Belgium-Luxembourg 1,516; West Germany 1,024.
Quartz and quartzite	11,391	11,275	West Germany 6,993; Belgium-Luxembourg 3,410.
Sand, excluding metal bearing thousand tons	9,029	8,578	Belgium-Luxembourg 8,030.
Sulfur:			
Elemental	4,346	7,038	Mainly to Belgium-Luxembourg.
Sulfur dioxide	1,050	720	Belgium-Luxembourg 217.
Sulfuric acid	179,677	164,265	Belgium-Luxembourg 75,963; France 4,213.

See footnotes at end of table.

Table 2.—Netherlands: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Talc and steatite	740	1,556	Belgium-Luxembourg 643; West Germany 384.
Other nonmetals, n.e.s.:			
Oxides and hydroxides of magnesium, strontium, barium	326	205	West Germany 73; United Kingdom 67.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture thousand tons	51	65	West Germany 47.
Other do	73	84	Belgium-Luxembourg 51; United Kingdom 20.
Unspecified do	197	210	West Germany 87; France 58; Belgium-Luxembourg 54.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,037	5	NA.
Carbon black	79,347	67,807	France 33,654; West Germany 13,055.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	1,022	287	West Germany 211; Belgium-Luxembourg 50.
Briquets of anthracite and bituminous coal do	23	NA	
Coke and semicoke do	726	653	France 337; Belgium-Luxembourg 175; West Germany 76.
Gas:			
Manufactured do	145	NA	
Natural billion cubic feet	1,691	1,821	West Germany 904; Belgium-Luxembourg 398; France 344.
Hydrogen, helium, rare gases	14,288	15,449	West Germany 7,246; Belgium-Luxembourg 7,184.
Peat and peat briquets thousand tons	NA	58	Belgium-Luxembourg 43; France 9.
Petroleum:[4]			
Crude thousand 42-gallon barrels	4,343	5,439	United Kingdom 2,443; Belgium-Luxembourg 1,533; Italy 1,078.
Refinery products:			
Gasoline do	61,923	60,843	West Germany 34,910; United Kingdom 12,334; Belgium-Luxembourg 5,491.
Kerosine and jet fuel do	20,507	19,274	West Germany 6,076; United Kingdom 5,720; Denmark 1,496.
Distillate fuel oil do	96,473	102,292	West Germany 61,455; Belgium-Luxembourg 8,601; United Kingdom 5,975.
Residual fuel oil do	133,979	122,411	West Germany 14,033; United Kingdom 10,476; Belgium-Luxembourg 10,250.
Lubricants do	4,005	3,057	Belgium-Luxembourg 453; United Kingdom 393.
Other:			
Liquefied petroleum gas do	4,483	5,290	Belgium-Luxembourg 2,598; Portugal 1,079.
Mineral jelly and wax do	810	504	West Germany 150; Morocco 110; United Kingdom 87.
Bituminous mixtures do	283	242	France 204.
Unspecified do	4,209	4,200	West Germany 1,379; Denmark 686; Norway 490.
Total do	326,672	318,113	
Mineral tar and coal-, petroleum-, or gas-derived crude chemicals thousand tons	545	459	West Germany 193; United Kingdom 128; Belgium-Luxembourg 47.

r Revised. NA Not available.

[1] Excludes monetary gold.

[2] Includes sponge iron, shot, grit, pellets, powder, spiegeleisen, and ferromanganese.

[3] Exports of ash and residue containing aluminum to Belgium-Luxembourg are included in "Ash and residue, other."

[4] Includes bunkers.

Table 3.—Netherlands: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite	141,285	152,732	Greece 140,715.
Alumina	526,327	576,816	Surinam 218,475; France 159,650; Greece 119,218.
Metal including alloys:			
Scrap	16,744	24,728	West Germany 14,485; United Kingdom 2,200.
Unwrought	158,758	121,389	Norway 63,409; West Germany 22,801.
Semimanufactures	83,248	63,885	West Germany 29,993; Belgium-Luxembourg 16,720.
Antimony metal including alloys, all forms	64	43	Belgium-Luxembourg 30; Italy 10.
Arsenic oxides and acids	839	740	France 436; Belgium-Luxembourg 132; People's Republic of China 83.
Beryllium metal including alloys, all forms	3	4	West Germany 3.
Bismuth metal including alloys, all forms	119	130	Belgium-Luxembourg 52; Japan 30.
Cadmium metal including alloys, all forms	94	73	Japan 18; Belgium-Luxembourg 15.
Chromium:			
Chromite	27,969	38,834	Republic of South Africa 23,930; Mozambique 10,097; Finland 4,348.
Oxides and hydroxides	1,052	880	West Germany 482; U.S.S.R. 150; France 118.
Metal including alloys, all forms	83	NA	
Cobalt:			
Oxides and hydroxides	338	186	Belgium-Luxembourg 147; France 23.
Metal including alloys, all forms	78	76	United States 39; United Kingdom 24.
Columbium and tantalum, tantalum	2	3	United States 2.
Copper:			
Copper sulfate	2,785	2,520	France 1,188; Belgium-Luxembourg 1,161.
Metal including alloys:			
Scrap	10,791	11,975	West Germany 4,711; United Kingdom 1,751.
Unwrought	49,157	49,529	Zaire 12,743; Belgium-Luxembourg 9,518; Chile 8,297.
Semimanufactures	77,325	65,013	Belgium-Luxembourg 27,322; West Germany 23,164; France 8,163.
Germanium metal including alloys, all forms	10	NA	
Gold [1] thousand troy ounces	1,349	2,409	West Germany 1,460; Switzerland 471.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	7,061	7,369	Brazil 1,769; Sweden 1,537; Australia 688.
Metal:			
Scrap do	149	205	West Germany 109; Belgium-Luxembourg 46; United Kingdom 33.
Pig iron [2] do	81	106	West Germany 40; Norway 23; France 11.
Ferroalloys do	55	47	Norway 21; France 8; West Germany 7.
Steel, primary forms do	630	372	Norway 134; Belgium-Luxembourg 117; West Germany 97.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	1,459	1,140	West Germany 467; Belgium-Luxembourg 461; France 114.
Universals, plates, sheets do	1,417	1,059	West Germany 505; Belgium-Luxembourg 383.
Hoop and strip do	242	32,368	Belgium-Luxembourg 32,228.
Rails and accessories do	53	47	West Germany 25; France 16; Belgium-Luxembourg 6.
Wire do	103	82	West Germany 39; Belgium-Luxembourg 36.
Tubes, pipes, fittings do	985	784	West Germany 561; Belgium-Luxembourg 42; United Kingdom 38.
Castings and forgings, rough do	16	13	West Germany 7; Belgium-Luxembourg 4.

See footnotes at end of table.

Table 3.—Netherlands: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Lead:			
Oxides	13,471	9,378	West Germany 4,174; France 2,529; Belgium-Luxembourg 1,813.
Metal including alloys:			
Scrap	20,489	19,291	West Germany 7,081; United States 4,881; United Kingdom 3,092; Sweden 2,678.
Unwrought	46,888	43,879	United Kingdom 16,076; Australia 11,682; Belgium-Luxembourg 7,638.
Semimanufactures	2,697	2,664	Belgium-Luxembourg 1,778; West Germany 620.
Magnesium metal including alloys:			
Scrap	656	948	West Germany 288; Norway 180.
Unwrought	2,907	2,555	United States 981; France 395; West Germany 297; Norway 293.
Semimanufactures	180	137	West Germany 67; France 45.
Manganese:			
Ore and concentrate	69,681	47,330	West Germany 2,103.
Oxide	1,096	789	Belgium-Luxembourg 703.
Mercury 76-pound flasks	884	2,727	France 2,697.
Molybdenum metal including alloys, all forms	170	172	West Germany 75; France 39; United Kingdom 21; United States 17.
Nickel:			
Matte, speiss, similar materials	1,309	384	All from Cuba.
Metal including alloys:			
Scrap	3,317	2,396	United Kingdom 947; West Germany 841; United States 261.
Unwrought	4,831	4,394	United Kingdom 1,347.
Semimanufactures	4,567	4,261	Sweden 2,195; West Germany 835; Belgium-Luxembourg 500.
Platinum-group metals, all forms thousand troy ounces	76	231	United Kingdom 206.
Silver metal including alloys, all forms do	6,489	337	West Germany 265; France 40.
Tellurium, elemental, and arsenic	30	29	United States 21; Sweden 8.
Tin:			
Ore and concentrate	2,375	3,083	Chile 1,615; Republic of South Africa 717; Burma 417.
Oxide	196	41	West Germany 21; United Kingdom 12; United States 8.
Metal including alloys:			
Scrap	728	540	Mainly from West Germany.
Unwrought	6,713	4,362	United Kingdom 1,393; West Germany 613.
Semimanufactures	111	88	Mainly from West Germany.
Titanium:			
Ore and concentrate (ilmenite)	50,823	28,063	Australia 27,469.
Oxide	7,713	3,885	West Germany 2,555; France 472.
Metal including alloys, all forms	317	189	United States 99; West Germany 36; Sweden 23.
Tungsten:			
Ore and concentrate	3,428	1,880	Chile 859; Peru 576; Portugal 310.
Metal including alloys, all forms	381	243	Belgium-Luxembourg 140; West Germany 32; United States 29; United Kingdom 24.
Zinc:			
Ore and concentrate	205,898	295,722	Australia 113,197; Canada 108,063; West Germany 32,121.
Oxides	5,917	3,022	Belgium-Luxembourg 914; France 772; West Germany 734; United Kingdom 371.
Metal including alloys:			
Scrap	8,066	4,031	West Germany 2,740; East Germany 487.
Dust (blue powder)	10,957	8,904	Belgium-Luxembourg 6,809; West Germany 1,729.
Unwrought	44,203	26,450	West Germany 9,591; Belgium-Luxembourg 9,059.
Semimanufactures	4,282	3,203	West Germany 1,687; Belgium-Luxembourg 1,421.

See footnotes at end of table.

Table 3.—Netherlands: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Other:			
Ores and concentrates of nonferrous metals, n.e.s	94,173	611,226	Australia 153,067; Greece 140,715; Canada 109,124.
Ash and residue containing nonferrous metals:			
Lead	3,034	3,368	West Germany 1,502; United States 844; Belgium-Luxembourg 374; United Kingdom 345.
Zinc	20,670	14,192	West Germany 10,317; East Germany 1,926.
Other	103,725	35,223	Canada 26,838.
Metals including alloys, all forms:			
Metalloids:			
Phosphorus	141	47	West Germany 36; Sweden 9.
Selenium	11	15	Norway 6; Japan 4; United Kingdom 2.
Silicon	1,340	2,599	Republic of South Africa 1,141; Spain 545; West Germany 375; France 362.
Alkali, alkaline earth, rare-earth metals	177	NA	
Base metals including alloys, all forms, n.e.s	1,125	2,310	Mozambique 682; Republic of South Africa 679.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc. thousand tons	184	561	West Germany 552.
Dust and powder of precious and semi-precious stones thousand carats	2,195	1,997	Ireland 1,479; United Kingdom 262.
Grinding and polishing stones	2,556	2,310	West Germany 1,141; United Kingdom 212.
Asbestos	48,237	35,852	Canada 21,826; Italy 6,658.
Barite and witherite	126,773	118,829	Peru 96,182; Morocco 10,280; Ireland 8,534; West Germany 2,643.
Boron materials:			
Crude natural borates	395,847	384,768	United States 368,945.
Oxide and acid	2,862	2,379	Turkey 767; United States 690; France 543; Belgium-Luxembourg 286.
Cement thousand tons	2,211	2,056	West Germany 1,252.
Chalk	128,816	93,296	France 43,276; Belgium-Luxembourg 34,679; West Germany 12,672.
Clays and clay products:			
Crude clays:			
Bentonite[3] thousand tons	32	42	United States 25; Greece 8; West Germany 7.
Kaolin do	413	309	United Kingdom 147; West Germany 106.
Refractory do	34	26	West Germany 8; France 5.
Other[3] do	485	NA	
Products:			
Refractory, including nonclay brick do	76	66	West Germany 38; United Kingdom 17.
Nonrefractory do	239	218	West Germany 122; Belgium-Luxembourg 41.
Cryolite and chiolite	499	641	All from Denmark.
Diamond, all types thousand carats	2,454	1,811	United Kingdom 518; Belgium-Luxembourg 497; Burundi 253; Ireland 237.
Diatomite and other infusorial earth	13,736	15,482	Denmark 7,355; France 2,730; Spain 2,008; United States 1,642.
Feldspar, fluorspar, leucite	68,764	59,935	Belgium-Luxembourg 7,779.
Fertilizer materials:			
Crude:			
Nitrogenous	26,663	12,900	All from Chile.
Phosphatic thousand tons	2,365	1,591	Morocco 522; United States 516; Togo 355; Senegal 159.
Potassic salts do	9	9	Mainly from West Germany.
Other do	55	57	West Germany 51.
Manufactured:			
Nitrogenous do	83	112	West Germany 33; France 22; Portugal 21; United Kingdom 19.

See footnotes at end of table.

Table 3.—Netherlands: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Fertilizer materials—Continued			
Manufactured—Continued			
Phosphatic:			
Thomas slag (P_2O_5 content) thousand tons	17	16	Belgium-Luxembourg 15.
Other (P_2O_5 content) ---do---	12	39	Tunisia 28.
Potassic ---do---	442	309	West Germany 121; East Germany 42; France 40; Belgium-Luxembourg 40; U.S.S.R. 40.
Other including mixed ---do---	124	52	West Germany 26; Belgium-Luxembourg 18.
Ammonia	3,416	4,854	West Germany 3,266; France 1,586.
Graphite, natural	437	388	West Germany 141; People's Republic of China 135.
Gypsum and plasters ---thousand tons---	356	377	France 185; West Germany 182.
Lime ---do---	1,056	874	Belgium-Luxembourg 507; West Germany 366.
Magnesite	61,504	76,007	Greece 35,201; North Korea 17,762; Austria 8,373.
Mica:			
Crude including splittings and waste	1,737	1,653	Republic of South Africa 762; Norway 333; United Kingdom 257.
Worked including agglomerated splittings	55	36	Switzerland 12; Belgium-Luxembourg 10.
Pigments, mineral:			
Natural crude	2,033	1,517	Austria 638; West Germany 562; Cyprus 161.
Iron oxides, processed	13,473	10,476	West Germany 9,283.
Precious and semiprecious stones, except diamond ---kilograms---	270,460	43,228	Japan 35,990; United Kingdom 6,274.
Pyrite (gross weight)	207	229	Italy 27.
Salt	24,448	24,318	West Germany 12,847; France 4,749.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	164,757	152,315	West Germany 106,946; Belgium-Luxembourg 38,588.
Caustic potash	7,159	1,447	West Germany 929; France 404.
Stone, sand and gravel:			
Dimension stone:			
Unworked and partly worked thousand tons---	1,375	330	West Germany 176; Belgium-Luxembourg 104.
Worked	42,608	36,760	Italy 17,891; West Germany 7,234.
Dolomite ---thousand tons---	823	797	Belgium-Luxembourg 717.
Gravel and crushed rock ---do---	14,407	4,171	West Germany 2,778; Belgium-Luxembourg 890; France 466.
Limestone ---do---	752	750	Belgium-Luxembourg 694.
Quartz and quartzite	28,719	28,097	Belgium-Luxembourg 12,503; Norway 12,200.
Sand, excluding metal bearing thousand tons---	7,368	7,349	West Germany 6,773.
Sulfur:			
Elemental ---do---	498	348	United States 266.
Sulfur dioxide	50	4	West Germany 3.
Sulfuric acid	297,933	156,527	West Germany 143,694.
Talc and steatite	15,651	13,999	Austria 5,923; Norway 4,269.
Other nonmetals, n.e.s.:			
Crude:			
Quartz, electronic grade ---kilograms---	123	NA	
Other ---thousand tons---	1,338	1,541	West Germany 1,178; Belgium-Luxembourg 354.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture do---	3,440	2,180	West Germany 1,886; Belgium-Luxembourg 287.
Slag and ash, n.e.s ---do---	707	593	West Germany 476; Belgium-Luxembourg 116.
Oxides of barium, strontium, magnesium	1,076	1,127	West Germany 488; Israel 210; United Kingdom 125.

See footnotes at end of table.

Table 3.—Netherlands: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,928	3,570	Mainly from United States.
Carbon black (including gas carbon)	11,537	9,731	West Germany 8,158.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	4,262	4,144	United States 1,465; West Germany 1,056; Poland 841; Australia 494.
Briquets of anthracite and bituminous coal do	7	8	Mainly from West Germany.
Lignite and lignite briquets do	18	13	Do.
Coke and semicoke do	797	497	West Germany 432.
Gas, natural thousand cubic feet	NA	71	All from West Germany.
Peat, including peat briquets thousand tons	179	217	West Germany 211.
Petroleum:[4]			
Crude thousand 42-gallon barrels	447,356	372,498	Iran 124,250; Saudi Arabia 88,774; United Arab Emirates 37,191.
Refinery products:			
Gasoline do	37,664	38,148	U.S.S.R. 10,073; Belgium-Luxembourg 6,324; United Kingdom 4,080.
Kerosine and jet fuel do	1,772	2,736	United Kingdom 535; Belgium-Luxembourg 457.
Distillate fuel oil do	14,786	25,454	U.S.S.R. 6,281; United Kingdom 6,214; Netherlands Antilles 3,111; Bahamas 1,619.
Residual fuel oil do	5,692	12,294	United Kingdom 2,404; Belgium-Luxembourg 1,978; Japan 1,099.
Lubricants do	1,893	1,592	Belgium-Luxembourg 513; France 320; West Germany 233; Italy 180.
Other:			
Liquefied petroleum gas do	455	487	West Germany 313; Belgium-Luxembourg 58.
Mineral jelly and wax do	359	220	West Germany 94; France 31; United Kingdom 31; Portugal 24.
Bituminous mixtures do	274	158	Belgium-Luxembourg 133; West Germany 18.
Unspecified do	4,851	5,532	United States 2,450; West Germany 1,606; Belgium-Luxembourg 1,246.
Total do	67,746	86,621	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals thousand tons	362	192	Belgium-Luxembourg 77; United States 33; United Kingdom 21; West Germany 19.

NA Not available.
[1] Excludes monetary gold.
[2] Includes spiegeleisen, sponge iron, shot, grit, and pellets.
[3] Imports of bentonite from Belgium-Luxembourg are included in other clays.
[4] Includes bunkers.

COMMODITY REVIEW

METALS

Aluminum.—The Netherlands has no domestic source of bauxite. The two aluminum smelters, which operated at near capacity, were affected only by a temporary shortage of electrical energy. The smelter at Delfzijl, operated by Aluminium Delfzijl N.V. (Billiton-Shell-ESTEL), had a capacity of 106,000 tons of ingots per year, and the Péchiney-Nederland N.V. (Péchiney Ugine Kuhlmann) smelter at Vlissingen had a capacity of 187,000 tons per year.

Iron and Steel.—In the face of an increasingly bleak outlook for steel, Hoogovens IJmuiden B.V. completed its third basic oxygen furnace in March, bringing crude steel capacity to 7.3 million tons per year, compared with 6.0 million tons in 1974 when an $80 million expansion was approved. Capacity should reach 8 million tons per year by 1980. During 1976, approval was granted for expansion to 11 million-tons-per-year capacity by 1985.

Plans by the West German consortium Thyssen-Krupp-Mannesmann to build an ore-pelletizing plant in the Rotterdam harbor area were rejected on environmental grounds by the provincial authorities of South Holland Province. The consortium was reluctant to proceed with an appeal in view of the extended effort that would be required and the consequent escalation of costs.

The Netherlands has no domestic source of iron ore, importing supplies from major world sources such as Sweden, Brazil, and Liberia. Hoogovens, a subsidiary of the Dutch-West German corporation ESTEL N.V., which in turn is a subsidiary of Hoesch AG and Koninklijke Nederlandsche Hoogovens en Staalfabrieken N.V., produced 93% of the 5.2 million tons of steel output in 1976; the remainder was produced by NKF-Staal B.V. at Alblasserdam (near Rotterdam), and Staalgietwerk SMDK N.V. (formerly Royal Demka Steelworks) at Utrecht.

Zinc.—Ore from the Nanisivik mine in Canada did not start arriving in 1976 as originally scheduled, forcing the zinc smelter at Budel to operate below capacity with concentrate largely from Australia. The smelter, the sole producer of primary zinc in the Netherlands, was operated by N.V. Kempensche Zink-Maatschappij and Australian Mining and Smelting Europe. Plant capacity was 150,000 tons per year of electrolytic zinc.

NONMETALS

Nitrogen.—The possibility of building an ammonia plant with a capacity of at least 1,000 tons per day at Eemshaven, north of Delfzijl in the northeast, was being considered by Windmill Holland B.V. Feedstock would be natural gas from either the nearby Groningen Field or the Dutch sector of the North Sea. This site was chosen over a site near the company's fertilizer plant at Vlaardingen because of lower gas prices, a 25% investment premium for that area, the deepwater port, and ample space for construction.

Three companies reportedly produced ammonia, but data on output were not published: Unie van Kunstmestfabrieken B.V., a subsidiary of Dutch State Mines, with a capacity of about 1.2 million tons of ammonia per year at Geleen, Pernis (Rotterdam) and IJmuiden; Nederlandse Stikstof Maatschappij N.V. with a capacity of about 600,000 tons per year at Sluiskil, southwest Netherlands; and Esso Chemie N.V. with a capacity of about 400,000 tons in the Europoort area of Rotterdam.

MINERAL FUELS

Energy.—The Netherlands was again a net energy exporter in 1975 because of its growing natural gas exports, but there was a decline in absolute quantity as petroleum trade decreased. Coal mining ceased in 1974, and as yet petroleum has not been discovered in major quantities.

The Government, in its annual budget message, announced that certain measures would be taken to limit the growth ratio of energy use to GNP to just over 1 to 1; this growth ratio was 1.8 to 1 prior to 1973 and had dropped to 1.5 to 1 by 1976. It was believed that the ratio would drop to 1.3 to 1 in the natural course, resulting in an energy demand of 99.9 million tons of oil equivalent[4] by 1985 compared with 62.3 million tons[5] in 1975. However, special measures, including conservation, insulation, and more efficient use, were expected to bring about the lower ratio. By 1985 the share of natural gas in total energy supply was also expected to decline to 38% from 58% in 1975.[6] Imported oil and some imported coal were to fill the gap. The Netherlands expected to again import 20% of its energy requirements in 1985. The energy balances for years 1974 and 1975 are shown in table 4.

[4] One ton oil equivalent equals 1.47 tons standard coal equivalent.
[5] Calculated on a more restricted basis than that of table 4.
[6] Calculated on a more restricted basis than that of table 4.

Table 4.—Netherlands: Supply and apparent consumption of fuels and power for 1974 and 1975
(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Nuclear power
1974:					
Production	114.9	0.8	2.2	111.5	0.4
Imports	107.4	5.0	102.4	--	--
Exports	123.4	1.7	63.5	58.0	.2
Apparent consumption	[2] 98.9	4.1	[2] 41.1	53.5	.2
1975:					
Production	111.8	--	2.2	109.1	.5
Imports	97.1	4.7	92.4	--	--
Exports	107.4	.9	47.3	59.2	--
Apparent consumption	101.5	3.8	47.3	49.9	.5

[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Includes refinery fuel, losses, and nonenergy uses.

Sources: 1974: Adapted from United Nations, World Energy Supplies 1950–1974, Statistical Papers, ser. J, No. 19, 1976, 825 pp.; 1975: Organization for Economic Cooperation and Development. Energy Statistics, 1973–1975, Paris, 1976.

Natural Gas. —Total reserves, proven and probable, of natural gas in the Netherlands declined 5.3% during 1976, as shown in the following tabulation, in billion cubic meters at 15° C:

	End of 1976		End of 1975	
	Proven	Probable	Proven	Probable
Groningen Field	1,567.1	203.8	1,649.7	200.8
Other onshore fields	85.5	123.1	99.7	187.0
Continental Shelf	106.5	260.9	98.8	241.3
Total	1,759.1	587.8	1,848.2	629.1

Source: Ministerie van Economische Zaken. "Aardgas en Aardolie in Nederland en op de Noordzee." 1975 and 1976.

This was the first significant decline since 1968, and, according to the Minister of Economic Affairs, it was largely attributable to the constant growth in production.

The decline was viewed with some concern because of the limited volume of new deposits discovered in areas of most promise. The State Geological Service pointed out that exploration at greater, presently unjustifiable depths will ultimately be important to long term supplies; strong Government stimulation to obtain a reliable picture of the energy potential in the ground was recommended.

Production of natural gas increased about 7% to 97 billion cubic meters. The Netherlands continued to be the largest exporter among the market economy countries, exporting more than half of its production. Natural gas was marketed within the country and in neighboring countries (chiefly West Germany, Belgium, and France) solely by N.V. Nederlandse Gasunie. The largest producer was Nederlandse Aardolie Maatschappij B.V. (NAM), owned by Royal Dutch/Shell and Exxon. NAM controlled the Groningen gasfield as well as the principal oilfields, Schoonebeek and Rijswijk.

Under a decree that took affect on April 23, the Netherlands Government increased its participation from 40% to 50% and profit sharing from 50% to 70% in the exploitation of oil and gas offshore in the North Sea. The new decree applied only to 9,000 square kilometers not yet allocated and 13,500 square kilometers for which exploration permits had been granted but which would revert to the State. Permits granted prior to April 23 would not be affected. Terms of exploration licenses were also reduced from 15 years to 10 years, fees were increased, minimum exploitation spending was increased from $2,200 to $5,500 per square

kilometer, and the term for surrender of half the concession was reduced from 10 years to 6 years. The new regulations reflected public criticism of the unusually high profits made by petroleum companies when the price of oil was raised in 1973, but they were apparently less severe than corresponding British and Norwegian regulations. However, oil companies operating in the Netherlands indicated that the new conditions might lead to some offshore gasfields not being developed.

Petroleum.—After a quarter of a century of robust expansion, in which the Netherlands and particularly the city of Rotterdam became one of the world petroleum industry's leading refining centers, the industry was severely affected by the events of the seventies. In 1975 refineries operated at about 50% to 60% of capacity, and the figure improved to only about 65% in 1976, corresponding to a production of about 490 million barrels (65 million tons). Both exports, which take about 60% of the output, and domestic consumption were below the previous normal level, and a slow growth was forecast. There was an anomalous rise in domestic consumption of motor gasoline, however, and both British Petroleum (BP) and Shell announced plans that would shift output toward the lighter end of the barrel.

BP's plans, costing $240 million, included a vacuum distillation plant, installation of a catalytic cracker, an alkylizing plant, and a viscosity breaker unit. Consequently, production of fuel oil will decline 50%. Royal Dutch/Shell's investments included $80 million for construction of a new naphtha-hydrocracker. Identical plans by Esso to increase output of lighter petroleum fractions were under study.

In July the Dutch Cabinet suspended the fee on new investment in the Rijnmond area west of Rotterdam that was designed to prevent excessive industrial concentration there, in order to boost the economy. Oil-related activities in the area would benefit.

Total capacity of the eight Dutch oil refineries remained at about 100 million tons per year or roughly 2 million barrels per day; five of the refineries, with over 85% of the capacity, were in the Rotterdam area.

Reserves of petroleum in the Netherlands amounted to 40.4 million cubic meters (337 million barrels) in the Schoonebeek concession near the West German border at the end of 1976, of which 8.3 million cubic meters (70 million barrels) were proven; in the Rijswijk concession near The Hague, total reserves were 8.8 million cubic meters (73 million barrels), of which 4.7 million cubic meters (39 million barrels) were proven. A promising oilfield of unknown size was discovered by NAM in 1975 in block F–3 in the northeast portion of the Dutch Continental Shelf; in 1976 oil was found by the Union Oil Co. of the Netherlands in the adjacent block F–2.

The Mineral Industry of New Zealand

By Walter C. Woodmansee [1]

The most significant developments in New Zealand's mineral industry in 1976 were in the mineral fuels sector, where construction of production facilities was started at the offshore Kaui gasfield and neared completion at the onshore Kapuni gasfield. The Department of Mines initiated a new coal resource assessment program to define coal reserves more completely and accurately. Plans called for substantial increases in coal production for fueling new electric powerplants. Oil exploration, which was mainly offshore, was at a low level owing mainly to uncertainty concerning a new Government policy on petroleum exploration and development.

Production of iron sands for New Zealand's only direct-reduction plant and steelworks and for export to Japan reached a new high. Both iron sand-producing companies—New Zealand Steel Ltd. and Waipipi Iron Sands Ltd.—planned to increase iron sand production and exports, and New Zealand Steel planned to develop new sponge iron and steelmaking capacity as part of a multiyear development program.

In the nonmetals sector, a new sulfur-processing plant was under construction. Quarry and pit activity was high for sand and gravel, stone, and clay, New Zealand's most widespread exploration and mining operations.

The mineral exploration programs of a number of companies gained momentum on both the North and South Islands during the year. Principal metals sought were copper, gold, lead, and zinc. Applications for prospecting licenses continued to attract opposition from environmentalists. The Government believed that it provided adequate safeguards for environmental protection and enhancement in exploration and mining operations. Amendments to the Mining Act which would provide greater environmental protection in national parks were under consideration at yearend.

In October, the Minister of Energy Resources announced a new energy policy, effective in 1977. Coal prices were to be increased 25% (to average about two-thirds of the fuel oil market price); natural gas, 40% (to average about 15% below the fuel oil price); manufactured gas, 25% to 30%; and electricity rates, 40%. In addition, energy resource taxes were to be introduced to finance energy exploration, development, marketing, research, and conservation programs. The levy on coal was set at $2 per ton; natural gas, $0.0475 per therm; and petroleum liquids, $3 per barrel.[2] The former regulation, which provided for 40% Government participation in oil exploration and development costs in return for 51% of any future return, was dropped. The Government added an excise tax of 10% to 15% on profits from future petroleum production.

The energy strategy was to reduce dependence on imported energy, currently

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[2] The New Zealand dollar ($NZ) and U.S. dollar were near parity during most of 1976, and no currency conversions were made for this chapter. In December, the New Zealand dollar was devaluated 17.5% against all currencies except the Australian dollar, and, at yearend, the conversion rate was $NZ1.099=US$1.00.

60%, to 30% of total primary energy requirements by 1985. The Committee to Review Power Requirements, organized in 1975, projected generation of electricity at 39,800 gigawatts in 1984–85. The 1974–75 rate was 18,300 gigawatts. Energy sources for 1981 were forecast as follows: Petroleum 49%, electricity 29%, coal 14%, natural gas 7%, and manufactured gas 1%. The 1976 Power Plan provided for decisions on nuclear power development probably in 1978 and possible installation of the first nuclear facility after 1990.

In order to reduce the need for petroleum imports, the policy was to develop and utilize more coal, natural gas, and hydroelectric resources, and to reduce overall energy demand by conservation practices. Although initial natural gas produced at the Kapuni and Kaui gasfields will fuel electric power stations, this practice is to be phased out, with coal replacing gas as fuel. Potential development of geothermal energy was considered limited because the main geothermal resources were in tourist areas.

PRODUCTION

Production levels for New Zealand's most important mineral commodities—natural gas, sand and gravel, coal, and iron sands—were similar to or higher than those of 1975. The most marked increase was in output of natural gas and condensate. Sand and gravel output was down slightly, but output of coal and iron sands was slightly higher.

Output values of some of the principal nonmetallic mineral commodities were as follows:

	Value (thousands)
Sand and gravel	$44,555
Stone:	
Limestone (for agriculture, roads, industry, cement)	9,631
Dolomite	405
Dimension stone	341
Greenstone	60
Clays:	
Fire clay	772
Ceramic clay	543
Bentonite	42
Serpentine	538
Salt	516
Sand, glass	484
Pumice	130
Other nonmetals	89

Output of gold was valued at $425,000. Value data were not available for other major mineral and metal products, such as natural gas, iron sands, aluminum metal, and cement. On the basis of a price of $11.50 per ton, coal production was valued at approximately $28.6 million.

Table 1.—New Zealand: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum, smelter production	110,300	108,600	139,800
Gold, mine output, metal content ---troy ounces--	4,710	2,747	3,276
Iron and steel:			
Iron ore, gross weight	219	329	185
Iron sand, gross weight [1]	2,352,653	2,297,056	2,473,487
Sponge iron e ---thousand tons--	130	r 160	160
Crude steel ---do---	194	198	e 200
Silver, mine output, metal content ---troy ounces--	1,814	e 2,000	498
Tungsten, mine output, metal content	4	--	e 6
NONMETALS			
Cement, hydraulic ---thousand tons--	1,068	1,085	999
Clays:			
Bentonite	5,069	5,246	1,042
Fire clay	257,389	211,423	260,811
Kaolin (including china clay)	16,711	26,997	58,834
Diatomite	4,558	3,055	e 3,000
Magnesite	826	791	805
Perlite	465	1,500	1,500
Pumice	70,328	37,857	50,232
Salt	54,864	40,000	43,000
Sand and gravel:			
Glass sand	148,633	147,738	142,955
Common sand and gravel [2] ---thousand tons--	27,624	22,628	20,881
Stone:			
Dolomite	20,935	13,598	23,129
Greenstone	6	r e 6	6
Limestone and marl:			
For agriculture ---thousand tons--	1,540	1,502	1,686
For roads ---do---	134	NA	274
For industry, except cement ---do---	114	125	165
For cement ---do---	1,884	1,838	1,674
Serpentine ---do---	89	60	72
Unspecified:			
Dimension	35,085	23,091	26,328
Rock for harbor work ---thousand tons--	2,132	3,296	NA
Sulfur	224	585	825
MINERAL FUELS AND RELATED MATERIALS			
Carbon dioxide, natural (produced with natural gas) million cubic feet--	6,667	e 7,300	NA
Coal:			
Bituminous ---thousand tons--	422	457	445
Subbituminous ---do---	1,998	1,819	1,872
Lignite ---do---	144	136	170
Total ---do---	2,564	2,412	2,487
Coke, gashouse ---do---	31	30	41
Fuel briquets ---do---	3	--	11
Gas, natural: [3]			
Gross production ---million cubic feet--	r 10,647	11,500	32,000
Marketed production ---do---	10,594	11,442	30,945
Natural gas liquids ---thousand 42-gallon barrels--	25	34	86
Petroleum:			
Crude [4] ---do---	1,385	1,423	3,776
Refinery products:			
Gasoline ---do---	10,783	10,402	12,052
Distillate fuel oil ---do---	4,578	4,219	5,168
Residual fuel oil ---do---	9,607	6,722	7,795
Other ---do---	763	505	674
Refinery fuel and losses ---do---	2,167	1,568	1,704
Total ---do---	27,898	23,416	27,393

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Average 60% iron.

[2] Includes crushed rock for building aggregate, roads, and ballast.

[3] Excludes carbon dioxide component of natural gas, which is reported separately.

[4] Includes crude oil and field condensate.

TRADE

New Zealand's worsening trade deficit was attributed to reduced export demand for agricultural products, which, with forestry products, have accounted for 85% of total export value, and to higher prices for imported crude petroleum, petroleum refinery products, and manufactured goods. Petroleum imports were valued at $430 million for the year ending June 1976 and were expected to be higher in 1977. Approximately one-half of the national energy demand was derived from imported sources.

According to the Department of Statistics, principal mineral commodity exports (provisional) in 1976 were iron sand concentrates (2,146,625 tons) and aluminum and its alloys (98,369 tons). Principal mineral commodity imports in 1976 are given in table 4.

Table 2.—New Zealand: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys:			
Scrap	1,824	1,136	Australia 899; Japan 166.
Unwrought and semimanufactures	87,654	91,248	Japan 88,932.
Copper metal including alloys:			
Scrap	3,251	896	Australia 433; United Kingdom 247; Netherlands 216.
Unwrought and semimanufactures	144	600	Singapore 207; Australia 149; Malaysia 106.
Iron and steel:			
Ore and concentrate—thousand tons	2,234	2,293	All to Japan.
Metal:			
Scrap	2,399	2,058	Japan 932; Netherlands 705.
Semimanufactures:			
Bars, rods, angles, shapes, sections	3,864	7,137	Fiji 1,989; Canada 1,743; United States 1,532.
Universals, plates, sheets	28,551	28,075	Pakistan 10,518; United States 9,062.
Hoop and strip	370	257	All to Malaysia.
Wire	672	1,239	Fiji 557; United States 196.
Tubes, pipes, fittings	862	1,963	People's Republic of China 1,360; Singapore 260.
Lead metal including alloys:			
Scrap	--	666	NA.
Unwrought and semimanufactures	279	129	Fiji 43.
Platinum-group metals and silver ores and concentrates—value, thousands	$1,665	$179	United Kingdom $146.
Zinc metal including alloys:			
Scrap and blue powder	299	1,012	West Germany 406; Spain 131.
Unwrought and semimanufactures	43	--	
Other:			
Ores and concentrates	55	--	
Ash and residue containing nonferrous metals—value, thousands	$564	$199	Australia $65.
Oxides, hydroxides, peroxides of metals, n.e.s—do	$251	--	
NONMETALS			
Cement	5,088	5,400	New Caledonia 1,882; Nauru 750.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s	5,938	--	
Products:			
Refractory (including nonclay bricks) value, thousands	$61	--	
Nonrefractory—do	$132	$146	Australia $54.
Fertilizer materials, manufactured:			
Phosphatic	3,117	4,654	Fiji 4,597.
Potassic	856	--	
Other, including mixed	151	207	Australia 128.
Precious and semiprecious stones, except diamond, natural—value, thousands	$279	--	
Other nonmetals: Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s—do	$380	$201	Fiji $96; Samoa $50.
MINERAL FUELS AND RELATED MATERIALS			
Coke and semicoke	7,828	5,254	All to Republic of Korea.
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	--	4	Mainly to ship stores.
Kerosine, white spirit—do	--	202	All to ship stores.
Distillate fuel oil—do	765	1,089	Ship stores 1,083.
Residual fuel oil—do	1,117	1,091	Ship stores 1,089.
Lubricants—value, thousands	$397	$369	Fiji $195; ship stores $114.

NA Not available.

Table 3.—New Zealand: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	531	546	Guyana 508.
Oxide and hydroxide	213,021	235,721	Australia 231,368.
Metal including alloys:			
Unwrought	1,329	1,479	Australia 1,428.
Semimanufactures	9,226	4,229	United States 1,159; United Kingdom 1,086; Australia 629.
Arsenic trioxide, pentoxide, acids	1,537	1,626	United Kingdom 1,474.
Chromium oxide and hydroxide	290	99	West Germany 38.
Cobalt oxide and hydroxide	7	8	Belgium-Luxembourg 7.
Copper metal including alloys:			
Unwrought	2,276	973	Australia 676; United Kingdom 297.
Semimanufactures	[1] 12,108	[1] 11,003	Australia 9,207; United Kingdom 989.
Iron and steel metal:			
Scrap	15,440	27,257	United States 19,644; Australia 4,332.
Pig iron, ferroalloys, similar materials	10,869	6,505	Australia 3,502; Republic of South Africa 1,358.
Steel, primary forms	28,766	1,726	Australia 1,635.
Semimanufactures:			
Bars, rods, angles, shapes, sections	192,048	77,571	Australia 33,978; Japan 28,423; United Kingdom 11,762.
Universals, plates, sheets	481,665	230,467	Japan 182,391; Australia 24,226.
Hoop and strip	26,280	15,447	Japan 6,316; Australia 5,312; United Kingdom 2,915.
Rails and accessories	6,088	21,720	United Kingdom 19,382; Australia 2,193.
Wire	36,877	17,024	Japan 5,691; Australia 5,615; United Kingdom 4,595.
Tubes, pipes, fittings	45,169	106,458	Japan 83,115; Australia 12,821.
Castings and forgings, rough	272	257	Australia 217; United Kingdom 33.
Lead:			
Oxides	431	230	Australia 217.
Metal including alloys, all forms	8,104	7,722	Australia 7,635.
Magnesium metal including alloys, unwrought	272	--	
Manganese:			
Ore and concentrate	531	--	
Oxides	1,010	997	Australia 422; United States 413.
Nickel metal including alloys:			
Unwrought	118	109	All from Canada.
Semimanufactures	210	144	United Kingdom 61; Australia 43; United States 17.
Platinum-group metals and silver:			
Waste and sweepings, value, thousands	$258	$230	All from Australia.
Metals including alloys:			
Platinum-group, do.	$280	$221	Australia $83; United Kingdom $53.
Silver, do.	$2,263	$1,863	Australia $1,517; United Kingdom $282.
Tin:			
Oxides	23	12	Australia 8.
Metal including alloys:			
Unwrought	339	296	Australia 292.
Semimanufactures	50	14	Australia 11.
Titanium oxides	1,942	1,370	Japan 642; Australia 638.
Tungsten metal including alloys, all forms value, thousands	$382	$275	United Kingdom $169; Netherlands $75.
Zinc:			
Oxide	81	82	United Kingdom 43.
Metal including alloys:			
Unwrought	21,005	15,869	Australia 15,856.
Semimanufactures	628	348	Australia 213; United Kingdom 54; Japan 50.
Other:			
Ores and concentrates of molybdenum, tantalum, titanium, vanadium, zirconium	862	353	Australia 346.
Oxides, hydroxides, peroxides of metals, n.e.s	257	162	Belgium-Luxembourg 41; United Kingdom 39; Norway 30.

See footnote at end of table.

Table 3.—New Zealand: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Other—Continued			
Metals including alloys, all forms:			
Metalloids ——value, thousands	$614	$376	France $187; United Kingdom $93.
Base metals including alloys, all forms, n.e.s ——do	$622	$405	People's Republic of China $161; Australia $69; United States $64.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	139	146	NA.
Grinding and polishing wheels and stones value, thousands	$1,374	$1,356	United Kingdom $451; Australia $289; United States $135.
Asbestos	8,184	11,965	Canada 5,756; Republic of South Africa 4,414; Australia 1,365.
Barite and witherite	3,496	9,448	Australia 5,506; United States 3,374.
Boron materials:			
Crude natural borates—value, thousands	$178	$62	NA.
Oxide and acid	745	714	United States 660.
Cement	8,454	6,468	Japan 2,445; United Kingdom 1,721; Singapore 970.
Chalk	1,375	675	United Kingdom 445.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s	9,803	7,054	United States 5,153; United Kingdom 1,447.
Products:			
Refractory (including nonclay bricks) value, thousands	$4,165	$4,203	United Kingdom $1,777; Australia $887; United States $644.
Nonrefractory ——do	$938	$659	United Kingdom $272; Japan $254.
Diamond:			
Gem, not set or strung ——do	$2,445	$1,862	Republic of South Africa $818; United Kingdom $451; Israel $430.
Industrial ——do	$86	$113	Australia $51.
Diatomite and other infusorial earth	946	987	United States 933.
Feldspar, fluorspar, nepheline syenite	2,053	1,040	Norway 699.
Fertilizer materials:			
Crude:			
Nitrogenous	1,285	501	All from Chile.
Phosphatic ——thousand tons	1,027	1,129	Nauru 474; Australia 399; Gilbert Islands 256.
Manufactured:			
Nitrogenous ——value, thousands	$16,197	$5,165	Japan $2,883; Netherlands $1,616.
Phosphatic	5,322	1,420	Belgium-Luxembourg 1,348.
Potassic	235,823	210,916	United States 141,936; Canada 47,073; U.S.S.R. 19,216.
Other, including mixed value, thousands	$7,000	$4,155	United States $3,270.
Ammonia	450	1,190	Australia 1,186.
Graphite, natural	193	--	
Gypsum and plasters	171,611	159,876	Australia 159,278.
Magnesite	1,815	2,632	People's Republic of China 2,608.
Mica:			
Crude, including splittings and waste value, thousands	$81	$151	Australia $52.
Worked, including agglomerated splittings ——do	$214	$144	United Kingdom $83.
Pigments, mineral:			
Natural, crude	304	156	Austria 118.
Iron oxides, processed	1,164	460	West Germany 287.
Precious and semiprecious stones, except diamond:			
Natural ——value, thousands	$1,882	$1,347	Australia $560; Thailand $327.
Manufactured ——do	$105	$52	NA.
Salt	45,940	53,056	Netherlands 31,221; United Kingdom 19,456.

See footnote at end of table.

Table 3.—New Zealand: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Sodium and potassium compounds, n.e.s.:			
Caustic soda	9,509	17,646	United Kingdom 10,116; Australia 4,960.
Caustic potash, sodic and potassic peroxides	853	289	France 142.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	916	2,056	Brazil 901; Republic of South Africa 772.
Worked ——value, thousands	$209	$188	Italy $100.
Quartz and quartzite	780	594	NA.
Sulfur, elemental, other than colloidal	294,258	163,693	Canada 103,496; United States 59,948.
Talc, steatite, soapstone, pyrophyllite	2,318	2,756	Australia 1,968; People's Republic of China 672.
Other nonmetals:			
Crude ——value, thousands	$118	$153	Republic of South Africa $118.
Oxides and hydroxides of magnesium, strontium, barium	1,001	289	United States 140.
Bromine, iodine, fluorine	10	15	Japan 13.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s ——value, thousands	$2,233	$3,584	Australia $3,352.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	9,915	6,956	Australia 6,617.
Coal and briquets	1,806	4,717	United States 2,617; France 1,284; West Germany 599.
Coke and semicoke	3,673	2,844	Australia 2,835.
Gas, hydrocarbon ——value, thousands	$263	$59	NA.
Hydrogen and rare gases	312	739	Australia 720.
Peat, including peat briquets and litter	255	235	Canada 209.
Petroleum:			
Crude and partly refined:			
Crude —thousand 42-gallon barrels	18,263	16,343	Iran 7,783; Kuwait 5,532; Iraq 1,511.
Partly refined ——do	6,336	6,936	Australia 1,542; Kuwait 1,502; Iran 1,391.
Refinery products:			
Gasoline ——do	4,549	3,125	Australia 1,439; Iran 755; Singapore 377.
Kerosine and jet fuel ——do	2,496	2,163	Australia 1,622; Singapore 411.
Distillate fuel oil ——do	2,969	2,615	Australia 1,325; Singapore 463; Bahrain 396.
Residual fuel oil ——do	227	185	All from Australia.
Mineral jelly and wax ——do	51	35	Indonesia 12; Japan 9; Australia 5.
Lubricants ——value, thousands	$14,860	$15,439	Australia $7,501; United States $2,286; Singapore $2,084.
Other:			
Nonlubricating oils, n.e.s thousand 42-gallon barrels	65	75	Australia 34; United States 28; Singapore 9.
Pitch ——do	76	54	Mainly from Australia.
Bituminous mixtures, n.e.s.—do	12	8	United Kingdom 5; Australia 3.
Petroleum coke value, thousands	$2,544	$4,364	All from United States.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ——do	$1,929	$1,296	Japan $629; United States $227; Singapore $216.

NA Not available.

[1] Partial figure. Excludes copper foil, powders, and flakes valued in thousands at: 1974—$2,009 and 1975—$1,433.

Table 4.—New Zealand: Principal mineral commodity imports, 1976 [p]
(Metric tons unless otherwise specified)

Commodity	Quantity
METALS	
Aluminum:	
Metal including alloys	1,800
Oxide	294,125
Copper metal including alloys	12,361
Iron and steel:	
Pig iron and ingots	12,045
Semimanufactures	433,076
Lead metal including alloys	8,904
Silver, partly worked ---troy ounces--	1,837
NONMETALS	
Asbestos	9,167
Fertilizer materials:	
Phosphate	937,665
Potash	200,635
Gypsum	129,579
Salt	8,386
Soda, caustic	16,088
Sodium carbonate	28,109
Sulfur	196,215
MINERAL FUELS	
Petroleum:	
Crude and partly refined	2,761,706
Refinery products:	
Gasoline ---thousand 42-gallon barrels--	4,582
Kerosine and white spirit ---do---	2,317
Distillate fuel oil ---do---	2,563
Lubricants ---do---	468

[p] Preliminary.

COMMODITY REVIEW

METALS

Gold.—Mine output was substantially higher than that of 1975. Kanieri Gold Dredging Ltd., using an 18-cubic-foot dredge, accounted for most of the production at its operation along the lower Taramakau River, west coast, South Island. During the first 7 months of the year, Kanieri worked 1,487,000 cubic meters of old tailings at the lower end of its dredging claim. During the remainder of the year, Kanieri dredged previously unworked ground in the lower end of its claim area, and recovered 2,431 troy ounces from 1,458,000 cubic meters of dredged placer material. Dredging was at an average depth of 23.5 meters. The Minister of Mines granted a dredging license to Kanieri for a new area downriver from the existing claim area.

Prospecting and exploration activity for gold was underway elsewhere on the South Island and also on the North Island. Pennzoil of Australia Ltd. conducted a detailed sampling program in the Collingwood area, west coast, South Island, with negative results. Other smaller-scale operations were seasonal. Ryan Mining Ltd. completed a 3-year evaluation program along the Shotover River.

Gold Mines of New Zealand Ltd., a subsidiary of Australian Anglo American Ltd., conducted a regional exploration program for gold in the North Cape and Raukumara Range-East Cape areas, North Island, and the Kaikouri Range, South Island.

Mineral Resources (New Zealand) Ltd. collected bulk samples of quartz vein in a westward extension of old surface workings at the Martha Mine, Waihi, North Island. Upper levels of the mine were also tested. The existing mill was modified to handle increased production, and a crusher was brought in from another mine. Trial treatment indicated that the gold was associated with extremely fine pyrite in the ore.

Iron Sands.—Output of iron sand concentrate at three locations on the west coast, North Island, reached a new high

of nearly 2.5 million tons. Exports to Japan totaled 2.1 million tons, compared with 2.3 million tons in 1975. New Zealand Steel Mining Ltd., a wholly-owned subsidiary of New Zealand Steel Ltd., planned to double capacity at Taharoa, between Auckland and New Plymouth, including installation of a second submarine pipeline to its deepwater, bulk-loading facility. The company had a sales agreement to export 11.8 million tons of iron sands to Japanese iron and steel firms.

Waipipi Iron Sands Ltd., a joint venture of Marcona Corp. (United States) and Viking Mining Corp. Ltd., commissioned a second dredge as part of its program to expand exports to 2 million tons per year to markets in Japan. The company had sales agreements with six Japanese iron and steel companies for delivery of 11 million tons of the iron sand concentrate.[3]

Iron and Steel.—For the year ending March 31, 1976, New Zealand Steel reported production of 113,135 tons of sponge iron at its direct-reduction kiln at Glenbrook, 58 kilometers south of Auckland. Iron sand concentrate from Waikato North Heads was the feed material. New Zealand Steel planned to install a new multiple-hearth furnace to boost sponge iron output 25%.

Production of ingots, billets, flat and corrugated galvanized sheet, pipe, and sections increased over 1975 rates. New Zealand Steel was studying a 10- to 15-year, $400 million development plan, which would increase annual capacity to 450,000 tons and add a 1-million-ton-per-year hot- and cold-rolling strip mill to avoid dependence on imports.[4]

Imports of iron and steel semimanufactures, mainly universals, plate, and sheet, were reduced to 433,076 tons from 468,944 tons in 1975.

Other Metals.—Prospecting was in progress for copper on Coromandel Peninsula, North Island, and on D'Urville Island, west coast, South Island, where soil sampling and a magnetic survey were conducted in a zone of alteration. Also in the west coast area, South Island, drilling was completed on a copper-lead-zinc prospect near the Baton River and on a copper-nickel prospect in the Riwaka complex.

Amoco Minerals New Zealand Ltd. applied for an exploration license to the Roaring Lion molybdenum prospect in the northwest Nelson District, South Island. Carpentaria Exploration Co. Pty. Ltd., the exploration company for Mount Isa Mines Ltd., Australia, terminated its long-term exploration project in the ilmenite sand areas, west coast, South Island.

A few tons of scheelite concentrate was recovered at the Glenorchy workings in the southern part of the South Island.

NONMETALS

Asbestos.—Asarco Exploration Co. of Canada Ltd. and associates carried out geological and sampling work at the Pyke prospect, northwest Otago, southern South Island. Late in the year, a drilling program was started.

Clays.—Bentonite was mined at Coalgate in Canterbury, South Island, and Porangahau in Hawke's Bay. Drilling grade bentonite was used in oil exploration in the Taranaki area. Bentonite was also exported for use in iron ore pelletizing in Tasmania, Japan, and Taiwan. Another clay, halloysite, was mined in the northern North Island for use in ceramics and as a filler in the paper industry.

Mineral Wax.—Wax with a high melting point was derived from peat deposits on the Chatham Islands. These deposits and lignites in central Otago and Southland continued under investigation by the Department of Scientific and Industrial Research.

Sulfur.—Taupo Quarries Ltd. started construction of a treatment plant and ancillary facilities at the 6-million-ton Rotokawa deposit, Taupo area, North Island. Development work continued on a process to separate the sulfur from the pumiceous ore. A small quantity of sulfur was produced at a pilotplant operation in 1976. Four vertical extraction towers were erected at the new processing plant.

Other Nonmetals.—Small tonnages of serpentine were produced at Piopio and the North Cape, North Island, and at Lee Valley, Collins Valley, and Mossburn, South Island.

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[3] Engineering and Mining Journal. New Zealand Uses Innovative Technique to Mine and Process Titanomagnetite. V. 177, No. 3, March 1976, pp. 246–248.

[4] Bold, D. A., and N. T. Evans. Direct Reduction Down Under: The New Zealand Story. Iron and Steel Institute, v. 50, No. 3, March 1977, pp. 145–152.

Quarry activity for sand and gravel and various types of stone was high, particularly near cities. Quarrying included both seasonal and full-time operations. Prospecting continued for good-quality materials. Winstone Ltd. reached full production at its Greywacke quarry near Hunua, North Island.

MINERAL FUELS

Coal.—Total output of bituminous coal, subbituminous coal, and lignite was slightly higher than that of 1975. There were 70 producing mines, 3 more than in 1975; 37 mines were underground operations (29% of output), and 33 mines were open pit operations (71% of output). About 78% of the total output was from State-owned mines. The trend continued toward greater mine mechanization, which resulted in better productivity and extraction percentage and fewer accidents. Hydromining was tested at the Escarpment mine, Buller District, South Island.

Demand was estimated at 3 million tons, distributed as follows: Electricity generation 40%, cement and lime industries 10%, household 7%, iron and steel industry 7%, and miscellaneous commercial-industrial heating and fueling 36%. The use of coal in thermal electric power stations was expected to expand as exploration and development continued for new deposits for this purpose. Three new mines at Huntly, under development for the new power station that was scheduled for completion in 1978, will produce more than 2 million tons per year when in full production. Output at the new, fully-mechanized Huntly West No. 1 mine, managed by Bechtel Pacific Corp. for the Department of Mines, was scheduled for 1.2 million tons per year and a 30-year life.[5]

Research on coal utilization, conducted by the New Zealand Coal Research Association (CRA), was financed by a tax of $0.075 per ton of coal produced and by Government grant. The Department of Mines and CRA advised consumers on efficient coal use.

The Department of Mines embarked on a 5-year exploration program to define coal resources more accurately. The program will include geological and topographic surveys, studies on coal chemistry, exploratory cuts and pits, shallow auger drilling, and deep core drilling. Initial work will be in Mataura District, southern South Island. Exploration continued in Buller and Greymouth Districts, South Island, and Waikato District, North Is-

[5] New Zealand Coal. March of Progress at Huntly. V. 21, No. 3, Winter 1977, pp. 2–5.

Table 5.—New Zealand: Coal statistics
(Metric tons unless otherwise specified)

Year	Production		Employment (number of workers)	Exports	Imports
	Open pit	Underground			
1974	1,758,813	r 805,504	1,581	37	250
1975	1,695,459	716,934	1,600	1,285	4,486
1976	1,764,113	722,791	1,528	10,394	1,345

r Revised.

Source: State Coal Mines. Mines Statement for Year Ended Dec. 31, 1976.

Table 6.—New Zealand: Estimated recoverable coal reserves in 1976, by type
(Thousand metric tons)

Type	Measured	Indicated	Inferred	Total
Bituminous	35,644	23,701	71,550	130,895
Subbituminous	190,386	127,600	230,350	548,336
Lignite	10,437	17,100	233,300	260,837
Total	236,467	168,401	535,200	940,068

Source: Department of Statistics, Wellington. New Zealand Official Yearbook, 1976.

land, to establish reserves sufficient for fueling new electric powerplants.

At yearend, reserves totaled 940 million tons, up 105 million tons as a result of resource assessment work during the year. These reserves were in 7 bituminous areas, 13 subbituminous areas, and 6 lignite areas. The principal districts were Waikato, with 379 million tons (measured, indicated, and inferred) of subbituminous coal of low to moderate ash and low sulfur; Buller, with 52 million tons of bituminous coal of low to moderate ash and low to high sulfur; Ohai (lower South Island), with more than 100 million tons (mostly inferred) of Waikato-type coal; and Mataura, with an undetermined but large resource of moderate-ash, low-sulfur coal exploitable by open pit.

Natural Gas.—Production increased sharply from the Kapuni gasfield, North Island, where development neared completion. Three new producing wells were completed, and others were in progress. A third processing train went onstream at the natural gas liquids plant of the National Gas Corp.

The Shell BP & Todd Oil Services Ltd. consortium continued development of the large Maui gasfield, 37 kilometers offshore from Kapuni in water 110 meters deep. The first development stage, for 600 million cubic feet per day, included production Platform A with 12 wells, an underwater gas and condensate pipeline, processing facilities at Oaonui, and more than 300 kilometers of onshore pipeline to two power stations. Construction work was delayed by adverse weather and sea conditions. The target date for first-stage completion remained late 1978 despite these delays.

Late in 1975, the Government's Offshore Mining Co. Ltd. announced receipt of a $200 million multicurrency loan to finance its 50% share in the project.

The second development stage, for 300 million cubic feet per day, scheduled for completion in 1983, included Platform B, additional underwater pipeline, and expanded processing facilities.

Petroleum.—Production of condensate from Kapuni gas more than doubled that of 1975.

Petroleum exploration was at a relatively low level, mainly owing to the new Government policy on taxing petroleum production. At yearend, there were 34 active exploration licenses covering 615,495 kilometers, both onshore and offshore. Offshore geophysical and geological surveys continued. The *Glomar Tasman* completed three wells, and *Penrod-74* completed two wells and was drilling a third at yearend. No significant discoveries were reported. The *Glomar Tasman* was drilling for a Shell BP & Aquitaine & Todd Petroleum Development Ltd. group and New Zealand Aquitaine Petroleum Ltd. alone. The *Penrod-74* was drilling for a Shell BP & Todd group and for Hunt International Petroleum Co. (of New Zealand).

New Zealand Petroleum Co. Ltd. was granted an exploration license to a 6,455-kilometer tract offshore from the west coast, South Island. Drilling was scheduled for 1977.

Hunt International suspended *Penrod-74* drilling operations following announcement of a $3-per-barrel tax levy on future oil production. This tax was abandoned in November because it was a disincentive to exploration. The Government planned to discuss a possible future tax on oil profits with the exploration companies.

The new petroleum policy, announced by the Minister of Mines in May, was also unfavorably received by the operating companies. This policy provided for no Government contribution to exploration costs (formerly 40%), continuation of a Government option for a 51% interest in any production program, a 10% royalty rate offshore, and a 15% royalty rate onshore.

The Mineral Industry of Nigeria

By Janice L. W. Jolly [1]

Oil exports valued at $10.2 billion[2] contributed 37.5% to the 1976 gross domestic product (GDP), estimated at $27.2 billion at current prices. Nigeria's industrial expansion continued unabated, fueled by petroleum revenues. Inflation also continued at an annual rate of more than 30%. Distribution bottlenecks, shortages, and other problems were defying short-run control. Strong Government measures had reduced the severe port congestion of 1975, but the problem was expected to continue until additional facilities could be completed. Constrictive Government policies were having the unintended effect of discouraging foreign investment, which is still deemed vital for balanced growth and technology transfer. Oil companies were awaiting improved investment incentives to be announced in 1977.

Six months after the new indigenization policy was first announced, the Nigerian Enterprises Promotion Decree was published in January 1977. The three-schedule decree superseded all previous measures and was to be implemented by December 31, 1978. Mining was included in schedule 2, and thus was to have at least 60% equity participation by Nigerians, both Government and private. Many of the industries in schedule 2 had formerly been required to be a minimum of 40% Nigerian owned, in compliance with the 1972 policy. In October 1976, the Nigerian Government acquired 60% controlling shares in foreign-owned banks. The compulsory acquisition was announced in June as the second phase of the 1972 indigenization program.

In early 1976, it was announced that a number of new States were to be created, resulting in a total of 19 smaller, more manageable units. The North Eastern State was split into the new States of Borno, Gongola, and Bauchi; and the densely populated Western State was divided into Oyo, Ogun, and Ondon. The Northwestern State was divided into Niger and Sokoto, Benue Plateau became Benue and Plateau, and Eastern became Anambra and Imo. Midwest State was renamed Bendel State, North Central was renamed Kaduna State, and South East was renamed Cross River State. Kwara, Kano, Rivers, and Lagos States remained unchanged.

Decree No. 46 of August 24, 1976, established the Nigerian Atomic Energy Commission. Under this decree, the commission was charged with prospecting and mining of radioactive minerals; constructing and maintaining nuclear installations for electricity; conducting research connected with atomic energy uses, and the manufacture or other production, purchase or other acquisition, treatment, storage, transportation, and disposal of any radioactive substances. Nigeria was to buy a nuclear powerplant from the Federal Republic of Germany.[3] Nigeria was a signatory to the nonproliferation treaty.

The Nigerian Government announced plans to carry out a geological survey of the entire country, expected to cost $650 million, as part of the national development plan. The Government-owned Nigerian Mining Corp. (NMC) announced that it would consider entering into partnership with any private company interested in mineral development during the ex-

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Nigerian naria (N) to U.S. dollars at the rate of N1.00=US$1.62.

[3] Industries et Travaux D'Outremer (Paris). Nigeria. V. 24., No. 275, September 1976, p. 670.

ploration program. The Government indicated that it may reintroduce a loan scheme for domestic mining companies. An $8 million mineral and metallurgical laboratory was to be established at Jos by the Mathews Ortech Co. for the Government. The French Bureau de Recherches Géologiques et Minières (BRGM) formed a new mineral research company (BRGM, Nigeria Ltd.) in which it held 51% of the equity.

PRODUCTION AND TRADE

Crude oil production returned to an upward trend in the last 3 months of 1976 and totaled 756.1 million barrels for the year, a 16% increase compared with 651.9 million barrels in 1975. Oil exports increased in the fourth quarter to 181.1 million barrels; total 1976 oil exports were 720 million barrels, a 19% increase compared with 1975. Earnings from oil exports increased 37% to $10.2 billion in 1976, and prospects were good that this trend would be maintained.

Nigerian tin production continued its downward trend. Operating at about one-third capacity, the Makeri smelter produced 3,667 tons of tin metal in 1976, compared with 4,677 tons in 1975. About 80 tons of tin was sold locally in Nigeria, the rest was exported and sold through the London Metal Exchange (LME). Rising costs of production and export controls have contributed to lower levels of recent years. Higher world prices in 1976, however, were hopefully paving the way for a reversal in Nigerian tin production and in the first months of 1977, production had begun to improve. The Fifth International Tin Agreement whose membership included Nigeria, came into effect July 1, 1976. Production of columbium as a coproduct of tin mining, and coal, suffering from a soft market have also declined in recent years.

The Nigerian trade surplus reached $2.54 billion in 1976, compared with $1.94 billion in 1975, an increase of 31%. Total exports for 1976 were estimated at $10.9 billion and imports, at $8.33 billion. Imports increased 38% in 1976 compared with that of 1975.

Nigeria signed a protocol with Togo on October 19, 1976, agreeing to supply 400,000 tons per year of blended light crude oil to Togo. The agreement provided an option for resale of excess refinery products to Nigeria and for supply of additional quantities of crude oil. The quantity specified was about 40% of the capacity of the new Togo refinery. Sierra Leone was already purchasing 201,000 tons of crude oil equivalent to 4,100 barrels per day. Supplies to Senegal, Togo, and Sierra Leone total 82,000 barrels per day, representing about 7% of Nigeria's 55% share of current production. In 1976, the United States imported an estimated 40% of Nigeria's total production.

Table 1.—Nigeria: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Columbium and tantalum:			
Columbite concentrate, gross weight	1,193	990	e 800
Tantalite concentrate, gross weight	1	1	e 100
Gold ---troy ounces	6	8	e 10
Lead, mine output, metal content e	220	130	276
Rare-earth metals, monazite concentrate	11	e r 20	e 20
Tin:			
Mine output, cassiterite concentrate:			
Gross weight	r 7,373	6,289	5,050
Tin content	5,455	4,652	3,700
Smelter	5,574	4,677	3,667
Tungsten ore and concentrate, gross weight	(1)	(1)	(1)
Zinc, ore and concentrate, metal content e	65	745	e 800
NONMETALS			
Cement, hydraulic ---thousand tons	1,238	1,364	e 1,543
Clays, unspecified	16,747	131,125	NA
Feldspar e	5,000	5,000	5,000
Stone:			
Limestone ---thousand tons	1,655	1,631	e 1,640
Marble	4,240	5,488	e 4,900
Shale ---thousand tons	198	197	e 197
MINERAL FUELS AND RELATED MATERIALS			
Coal ---thousand tons	r 314	e 300	e 300
Gas, natural:			
Gross production ---million cubic feet	1,017,774	658,839	e 764,000
Marketed production ---do	14,255	16,094	e 18,500
Petroleum:			
Crude ---thousand 42-gallon barrels	823,347	651,890	756,064
Refinery products:			
Gasoline ---do	5,301	4,658	5,270
Jet fuel ---do	709	1,412	NA
Kerosine ---do	2,209	2,587	3,001
Distillate fuel oil ---do	4,767	3,801	5,161
Residual fuel oil ---do	6,487	5,695	6,661
Lubricants ---do	--	469	NA
Other:			
Liquefied petroleum gas ---do	160	115	NA
Unspecified ---do	--	1,522	219
Refinery fuel and losses ---do	820	259	NA
Total ---do	20,453	20,518	20,312

e Estimate. p Preliminary. r Revised. NA Not available.
1 Less than ½ unit.

Table 2.—Nigeria: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Columbium and tantalum, ore and concentrate	2,277	979	Japan 455; United Kingdom 233; Netherlands 216.
Iron and steel metal, scrap	628	27	Belgium-Luxembourg 14; Netherlands 13.
Lead, ore and concentrate	242	177	Belgium-Luxembourg 101; United Kingdom 76.
Tin:			
Ores and concentrate	1	250	All to Netherlands.
Metal including alloys, all forms	5,762	4,729	United Kingdom 3,965; Netherlands 660.
Zinc:			
Ores and concentrate	1,230	--	
Metal including alloys	--	46	Mainly to France.
Zirconium, ore and concentrate	87	--	
Other nonferrous base metals, n.e.s.:			
Ore and concentrate	2,205	365	Mainly to Netherlands.
Scrap	8,089	1,574	Netherlands 920; Belgium-Luxembourg 282; West Germany 208.
NONMETALS			
Fertilizer materials, crude	(1)	14	All to Sierra Leone.
Lime	538	--	
Sodium and potassium compounds, n.e.s.:			
Ammonia and caustic potash	268	--	
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	8,896	516	Brazil 204; Netherlands 161; Denmark 100.
Coal and coke including briquets	17,214	31,024	Egypt 14,249; Ghana 12,775; West Germany 4,000.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	714,599	605,371	United States 183,915; United Kingdom 77,864; France 71,332.
Refinery products:			
Gasoline ---do---	117	77	Equatorial Customs Union [2] 62; Niger 15.
Jet fuel ---do---	226	110	Equatorial Customs Union [2] 97; Niger 9.
Kerosine ---do---	26	19	Equatorial Customs Union [2] 15; Ship stores 3.
Distillate fuel oil ---do---	398	443	Ship stores 226; Equatorial Customs Union [2] 105; Niger 101.
Residual fuel oil ---do---	570	2,196	United States 1,725; Netherlands 266.
Lubricants ---do---	12	7	Dahomey 2; Equatorial Customs Union [2] 2; Ship stores 1.
Mineral jelly and wax ---do---	(1)	--	
Nonlubricating oils, n.e.s ---do---	(1)	--	
Bitumen and bituminous mixtures, n.e.s ---do---	3	1	Mainly to Niger.
Total	1,352	2,853	

[1] Less than ½ unit.
[2] Consists of the Congo, Central African Republic, Chad, and Gabon.

Table 3.—Nigeria: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum, metal and alloys:			
Unwrought	1,258	3,298	Canada 1,968; West Germany 1,136.
Semimanufactures	15,043	19,939	United Kingdom 4,474; Switzerland 4,410; West Germany 3,339.
Copper, metal and alloys:			
Unwrought	232	4	Mainly from United Kingdom.
Semimanufactures	3,410	2,960	United Kingdom 1,083; West Germany 584; Canada 581.
Iron and steel:			
Ore and concentrate including roasted pyrite	--	16	All from Sweden.
Metal:			
Scrap	157	40	All from Poland.
Pig iron including cast iron	60	97	Mainly from United Kingdom.
Sponge iron including powder and shot	3,807	714	Mainly from Japan.
Spiegeleisen	129	25	All from United Kingdom.
Ferroalloys	306	745	Spain 428; Hong Kong 177; West Germany 136.
Steel, primary forms	114,406	73,519	West Germany 31,997; United States 14,434.
Semimanufactures	1,021,149	1,135,781	West Germany 883,865; Belgium-Luxembourg 132,816; Italy 98,889.
Lead, metal including alloys:			
Unwrought	51	115	Mainly from United Kingdom.
Semimanufactures	213	225	Do.
Nickel, metal including alloys:			
Unwrought	(1)	10	Mainly from Japan.
Semimanufactures	171	190	United States 59; People's Republic of China 44; Italy 40.
Platinum-group metals and silver:			
Ore and concentrate	22	42	All from United Kingdom.
Metal including alloys, all forms:			
Platinum group ----troy ounces--	r 605	1,802	Mainly from Italy.
Silver ----------do----	r 301	351	United Kingdom 246; Netherlands 104.
Tin, metal including alloys:			
Unwrought	21	63	Bulgaria 30; West Germany 25.
Semimanufactures	188	201,982	Mainly from United Kingdom.
Uranium and thorium, ore and concentrate	3	22	All from Sweden.
Zinc, metal including alloys:			
Unwrought	2,841	10,116	Zaire 3,403; Belgium-Luxembourg 2,512; Japan 1,728.
Semimanufactures	580	758	United Kingdom 303; Zaire 300; United States 147.
Other:			
Ore and concentrate of base metals, n.e.s	48	280	Mainly from United Kingdom.
Metals, nonferrous including alloys, all forms, n.e.s	6,446	11,162	Finland 5,202; Zaire 2,126; West Germany 1,229.
NONMETALS			
Abrasives:			
Natural	465	1,768	United States 1,453; France 200.
Grinding and polishing wheels and stones	649	415	United Kingdom 156; Italy 71; West Germany 54.
Asbestos	46,178	29,024	Canada 16,383; Italy 5,411; West Germany 2,847.
Cement, hydraulic	1,045,603	1,737,542	Greece 379,956; Spain 321,143; West Germany 158,968.
Clays and clay products (including all refractory brick)	r 20,293	28,090	Italy 7,372; United Kingdom 6,541; West Germany 4,064.
Diamond, industrial ----value, thousands--	r $120	$15	India $12; Japan $3.
Fertilizer materials:			
Crude	29,346	26,766	West Germany 12,325; Netherlands 7,730; Belgium-Luxembourg 3,987.

See footnotes at end of table.

Table 3.—Nigeria: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Fertilizer materials—Continued			
Manufactured:			
Nitrogenous	8,528	82,308	Belgium-Luxembourg 38,017; West Germany 35,456.
Phosphatic	73,018	62,588	West Germany 22,015; Belgium-Luxembourg 19,082.
Potassic	1,443	4,605	West Germany 2,846; Belgium-Luxembourg 1,757.
Other	800	1,462	West Germany 805; Belgium-Luxembourg 500.
Ammonia	1,018	2,865	West Germany 1,638; Netherlands 689; United Kingdom 358.
Lime	16,853	20,863	Greece 10,460; United Kingdom 9,062.
Mica, all forms	270	87	Italy 57; United Kingdom 23.
Pigments, mineral including processed iron oxides	3,446	4,161	United Kingdom 3,063; West Germany 545.
Precious and semiprecious stones, except diamond [2] ——value, thousands	r $241	$1,184	Mainly from India.
Salt, excluding brine	181,650	199,466	United Kingdom 148,127; West Germany 28,741.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	23,382	27,918	West Germany 11,823; United Kingdom 6,796.
Caustic potash, sodic and potassic peroxides	6,120	6,604	United Kingdom 3,282; West Germany 1,160; Spain 838.
Stone, sand and gravel:			
Worked	592	13,237	Mainly from United Kingdom.
Gravel and crushed rock	13,834	19,104	Morocco 15,182; Togo 1,993.
Sulfur, all types, other than sublimed	468	543	Mainly from United Kingdom.
Other nonmetals, n.e.s.:			
Crude	3,362	7,827	Ireland 6,604; United Kingdom 1,004.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	30,016	117,595	United Kingdom 37,497; Spain 17,241; West Germany 17,176.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	135,599	143,208	Greece 42,435; Morocco 31,970; Ireland 29,737.
Coke and coke including briquets	4,952	8,571	West Germany 6,499; United Kingdom 2,072.
Petroleum:			
Refinery products:			
Gasoline thousand 42-gallon barrels	2,730	4,317	Italy 1,334; Netherlands Antilles 809; Netherlands 572.
Kerosine ——do	257	675	Italy 262; Netherlands 123.
Jet fuel ——do	553	947	Netherlands Antilles 271; Netherlands 187; Italy 169.
Distillate fuel oil ——do	745	1,717	Italy 370; Netherlands 307; Venezuela 249.
Residual fuel oil ——do	6	150	Italy 76; Venezuela 57.
Lubricants ——do	r 474	394	United Kingdom 178; Netherlands 108.
Mineral jelly and wax ——do	39	52	Netherlands 21; United Kingdom 11; West Germany 10.
Bitumen and bituminous ——do	581	736	Netherlands Antilles 309; United Kingdom 159; Netherlands 103.
Other ——do	11	23	Netherlands Antilles 13; Netherlands 6.
Total ——do	5,396	9,011	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	934	77,218	Netherlands 48,098; United Kingdom 28,995.

r Revised.
[1] Less than ½ unit.
[2] Includes pearls.

COMMODITY REVIEW

METALS

Columbium and Tantalum.—The principal producers of columbite–tantalum minerals were Bisichi-Jantar (334 tons), Vectis Mines (234 tons) and Amalgamated Tin Mines of Nigeria Ltd. (ATMN) (156 tons). ATMN's one small primary columbite mine was closed down, but the possibility of its redevelopment on a larger scale was being kept under review, depending upon whether the price of columbite continued to improve and upon availablity of mining equipment.[4] Columbium production has declined in recent years owing to higher operating costs and delays in delivery of mining machinery and spare parts caused by the congestion of Port Lagos. Tin slag from the Makeri smelter was also a source of tantalum. Tantalum concentrates produced in Nigeria were estimated to contain 85 tons of tantalum pentoxide from all sources, excluding by-product tantalum from tin slag.

Iron and Steel.—At the end of February, the discovery of an iron ore deposit was announced with resources estimated at 400 million tons, and located in the region of Okene, 320 kilometers north of Lagos. The Nigerian Steel Development Authority (NSDA) continued with overall project management for the planned iron and steel industry expansion. The first stage of expansion was a rolling mill, using imported ingots, that will be in operation by 1981. A Nigerian company was to clear the site, and a British firm was to design a quarry-stone-crushing plant. The objective continued to be the establishment of a completely integrated steel mill capable of carrying out the entire steelmaking process, from receiving ore to producing rolled structural sections, with an ultimate goal of 5.2 million tons of steel produced per year. The U.S.S.R. was to undertake geological surveys, various plant designs, technical assistance and training, and startup of the mill.

Lead.—Nigeria's only active mine produced about 276 tons of lead used domestically for soldering. The Makeri smelter had started a program for recovering lead from old batteries, to be used for making solder. NMC was studying the lead-zinc mine, now inactive, at Ishiaja, south of Abakaliki in Arambra State with hopes of restoring activity.

Tin.—In 1976, the principal tin-producing companies on the Jos Plateau were ATMN, Bisichi-Jantar, Exlands, Gold & Base Metal Mines of Nigeria Ltd. (GBMM), Kaduna Syndicate, Tin and Associated Minerals, United Tin Areas, Vectis Tin Mines, and NMC. Tin concentrate production in 1976 was estimated to be about 5,050 tons. There had been a persistent fall in production since the peak reached in 1968 of 13,240 tons.

The Jos Plateau was plagued with numerous shortages during 1976, including shortages of gasoline, foodstuffs, and frequent power cuts. An increase of 25% in the cost of electricity supplies came into effect in October 1976. The cost of living for all mining company employees continued to rise as a result of the high level of inflation. This contributed to the industrial unrest during January 1976, when demands for full implementation of the Udoji Public Service Review Commission's recommendations were made by the unions. The resulting 40% wage increase imposed a heavy burden on the industry. An appeal was made by the Chamber of Mines and the Association of African Miners for a reduction in the royalty rate. In addition, the industry was suffering from a shortage of trained manpower. Now down to 19 expatriate employees, ATMN once had 180 and was finding recruiting difficult.

A water supply dam, proposed by the Government, was to be built at a locality that would flood acres of good tin mining. It was estimated that approximately 60,000 tons of tin reserves would be lost if the dam is constructed.

Alluvial mine area restoration conditions have been in effect since 1946. At present the company must make the surface flat after the ore is mined out; an 80% restoration is required. It was found that hydraulicking the soil back into position would many times allow trees and grasses to grow better than before. The companies pay compensation rates to farmers (owners) based on the type of ground; for example, in a congested area

[4] Mining Annual Review—1977. Columbium/Tantalum. Pp. 84–85.

the rates would be $89 per acre and $16 per tree.

During 1976, NMC acquired 40% of ATMN and was seeking an additional 14% in accordance with recent Government requirements. The Federal Government has recommended that Government-sponsored institutions and private Nigerian citizens should, by yearend 1978, have not less than a 60% equity interest in the mining industry. Another 6% of ATMN was to be reserved for employees. The Makeri smelter was also 40% Government-owned. The small tin company Exlands was contacted in April by NMC regarding greater Government participation, but GBMM and United Tin had not yet been approached.[5]

The tin royalty rate was 16%, based on the LME posted price, but because the LME price was higher than the actual price received by the companies, the royalty was an effective 17%. There was also a 45% profit tax, and restrictions were introduced on June 29, 1976, limiting the amount of dividends payable. A company cannot pay dividends in excess of 30% of the company's share in gross capital investment.

For the fiscal year ending March 31, 1976, ATMN produced 2,658 tons of tin concentrate and 184 tons of columbite.[6] The company's schedules of expenditures and profits for 1976 indicated that the total revenue received was $7,961 per ton. After deducting a royalty of $1,362, smelter charges of $382, production costs of $5,237 and a 45% profits tax, there was approximately $539 earned for each ton produced. Amalgamated Tin's net profits for the year to March 31, 1976 were down 70% compared with those of fiscal year 1974–75. The drop in profits was caused partly to the devaluation of the pound sterling against the Nigerian naria, and partly to the more than 30% inflation in Nigeria and its effect on operating costs.

Mining depth was beginning to pose a problem. The average depth mined in the past was 60 feet, but ATMN was planning to go eventually to 140 feet. The depth to bedrock in the active pit was 80 feet, and at the new pit site being developed, was 100 feet. An Anderson Manor conveyor belt system was to be used to remove overburden, along with two new bucket-wheel excavators and draglines.

Preparatory underground development and additional exploration continued at the Ririwai (Liruen) tin-zinc project located in Kano State about 120 miles north of Jos on the new Jos-Kano road. NMC was majority shareholder in the project and GBMM held 20% interest. Work completed at yearend on the joint-venture indicated that the deposit extended over a distance of 4.5 kilometers and contained more than 5 million tons of measured and inferred ore reserves. McKaye and Schnelling were consultants for the new mine and did the original survey. The tin-bearing veins at this mine were expected to be lower grade than the alluvial ores. When the new mining is started, the added production will double smelter needs. The smelter was also expected to modify its system to handle the high lead content from Liruen when production starts. The new mine also has an expected potential of an estimated 7,000 tons of zinc concentrates, some chalcopyrite, and significant amounts of silver-lead minerals. There was one wide vein of economic significance with considerable sphalerite and several smaller veins of lesser significance.

NONMETALS

Cement.—Two new cement plants were being constructed, one near Glsoko, to be finished in 1978, and one at Ashaka, to be finished by 1979–80. Producing plants were located at Nkalagu in Anambra State, Ukpilla in Bendel State, Calabar in Cross River State, Sokoto in Sokoto State, and Ewekoro in Ogun State. All facilities utilized local Cretaceous limestone. Cement was selling locally for $3.24 per bag, or $64.80 per ton. Cutler Hammer Europa won a contract to supply a 415-volt electrical control gear to the new cement works at Shagamu.

A $50 million expansion program was being carried out by Niger Cement Co. (NIGERCEM) at its Nkalagu factory in Anambra State and would enable the company to raise its annual production level 50% to 720,000 tons. A new cement plant was planned for Ondo State with its tentative location to be near Iti near Owo,

[5] Industries et Travaux D'Outremer (Paris). Nigeria. V. 24, No. 275, October 1976, p. 732.
[6] The Financial Times (London). Amalgamated Tin Mines of Nigeria (Holdings) Limited. Nov. 8, 1976, p. 15.

but no feasibility study has been made. The firm of Turner and Newall of Manchester, England, was also investing in the cement industry of Nigeria as Turners Asbestos Cement (Nigeria) at Enugu and as Turner Asbestos Cement at Kaduna.

The temporary ban placed on imports of cement in 1975 was lifted. At the time the ban was imposed, it was estimated that up to a 12-month supply of cement was on ships waiting to be unloaded. The massive importation of cement was due to increasing construction, which continued unabated. In spite of this pressure, domestic cement output contributed a relatively low percentage to the needed supply, but production was expected to increase steadily. Importers are now required to obtain clearance from the Ministry of Transport for deliveries, to prevent excessive imports at any one time.

Glass Sands, Quartzite.—A geological survey by the University of Ife determined that the sand at Igbokoda was suitable for the manufacture of sheet glass. Asahi Glass Co., Ltd. expressed interest in this project, located in Ondo State. Tokyo Glass Engineering and Planners Co., Ltd., signed a $4 million contract to reactivate a glass factory project that was closed down during the recent civil war. Discovery of quartzite reserves in Kano State resulted in the establishment of a glass industry there as a joint effort between the Government (85%) and a Hungarian company.[7]

MINERAL FUELS

Coal.—Nigeria's third development plan (1975–80) envisaged $116 million to be spent on construction of a coal carbonization plant and expansion of the Enugu coal mines. The National Coal Corp. (NCC) was expecting to upgrade its staff in order to undertake the expansion, and professionals were being recruited from Europe. The Polish company Katowic Arebowa was assisting with underground coal operations at Enugu. The NCC coal-crushing plant can handle 250 tons per hour, or 2,000 tons per day. There were four active coal mines—Okpara, Anyeama, Ribadu, and Okaba. The local coal market is very limited. The railroad and the National Electric Power Authority (NEPA) each used one-third of the coal production. NEPA used coal for a power station that was being phased out as new hydroelectric and thermal power stations were coming onstream. The coal station had a 15-megawatt capacity. NIGERCEM at Nkalagu takes the rest of the coal for cement production.

The NSDA, with Soviet assistance, was investigating coal in Lafia, where coking-type coal had been reported. The geological structure, however, may make mining difficult.

Natural Gas.—Gas production totaled about 670 billion cubic feet; of this, about 2.4% was sold to utilities and industrial consumers. The balance was flared. Although there was no liquefied natural gas (LNG) production, plans were being made for the construction of several plants. As raw input for an LNG plant, flared gas would be worth $93 million at an estimated value of 15 cents per 1,000 cubic feet. Gas reserves on January 1, 1977, were estimated to be 1,245 billion cubic meters, or 1.9% of the world's total.[8]

The Nigerian Federal Government signed an agreement on October 4, 1976, with Shell International Petroleum Co. Ltd. and British Petroleum for the construction of a $2.5 billion LNG plant at Bonny River. The plant was to have a capacity of 800 million cubic feet per day. The Government was to hold 60% of the equity, and Shell and BP were to hold 20% each. The project was to be executed in three stages and geared to meet U.S. market demands. A similar plant, to be located at Peterside, also in Rivers State, was to be jointly owned by the Government (60%), Phillips Petroleum (15%), Nigerian AGIP Oil Company Limited (15%), and Essence et Lubrificant de France (ELF) (10%).

Petroleum.— *General.*—On May 27, 1976, it was announced that the Ministry of Petroleum and Energy would henceforth be known as the Ministry of Petroleum Resources. The Nigerian Government was dedicated to major expansion of petroleum transportation and processing in the next 10 years. Expansion plans included gas-gathering and processing facilities, improved transportation and storage of crude oil for national security, expansion of the

[7] Standard Bank Review (London). Nigeria. March 1974, p. 16.

[8] Petroleum Economist (London). Nigeria, World Estimated Commercial Production of Natural and Proved Reserves. V. 44, No. 7, July 1977, p. 262.

country's refining capacity by 240,000 barrels per day, and creation of a petrochemical industry.

A combination of Government price increases and decreased pumping allowances cut company profits more than 36% per barrel in the first quarter of the year. Nigerian National Oil Co. (NNOC) boosted the price of its participation crude oil to local producers to $12.75 per barrel for the first quarter of 1976, the highest price for the grade set by any member of the Organization of Petroleum Exporting Countries (OPEC). On July 3, 1976, NNOC offered to sell in the third quarter of 1976 at $13.01 per barrel. However, a revision of gravity differentials was announced in July, backdated to Jan. 1, 1976, that reduced prices of heavier grades of Nigerian crude oil 7.5 cents per barrel, to $12.48. The reduction in the posted price led to a 6.6-cent-per-barrel cut in cost of equity oil to producers to $11.96 per barrel. High prices had resulted in a depressed demand for Nigerian oil although the light crude continued to be desirable because of its good refining characteristics. In addition to stimulating demand for heavier crudes, the Government hoped that the revised differentials would answer company criticism that profit levels were too low to justify new investment.[9]

Oil production in November was the highest level achieved in 2 years. Texaco Overseas (Nigeria) Petroleum Co.'s crude oil production returned to a normal level after the loading facilities were repaired in mid-October; Texaco had virtually shut down completely for the month of September while repairing a hose at its loading terminal. Completion of several new wells resulted in increased production from Nigerian AGIP Oil Company Limited, Phillips Oil Company (Nigeria) Ltd., and ELF. After repair of a broken pipeline at Bonny Terminal, Shell-BP Development Co. of Nigeria's (Shell-BP) output was also nearly back to normal by yearend.

Pan Ocean Oil Corp.'s onshore Ogharefe oilfield was brought onstream in July at a production rate of more than 12,000 barrels per day. Production was from 10 wells on a 445-square-mile tract, located about 50 miles inland and 20 miles south of Bénin City. The oilfield was linked to Shell-BP's Amukpe terminal by pipeline. Pan Ocean held a 100% working interest in the field. Beginning production in July, the field produces from Tertiary sands which are 9,500 to 11,000 feet deep.

Production from Ashland Oil (Nigeria) Co.'s Ossu Field was expected to start in 1977 and was to increase the company's output from 10,000 to 13,000 barrels per day. A pipeline between Ashland's Izombe Field and Brass River terminal was under construction.

In February, the Government was demanding the right, starting in July 1977, to provide tanker transportation for up to 50% of the volume of crude oil that it sells, to specify the currency in which payment is to be made, and to require buyers to give performance guarantee bonds. Each of these demands was expected to cause an increase in oil company costs. The country's first oil tanker, the 270,000-deadweight-ton *Oloibiri,* was launched. The tanker was built at a cost of $44.5 million at a Yugoslavian yard, and, reportedly, was to be managed by a British company.[10]

All shares of the Exxon marketing company, Esso Standard (Nigeria), were acquired by the Government in accordance with an agreement made in November 1976. The company was renamed Unipetrol (Nigeria). Exxon's involvement was purely marketing and all products sold were imported. Up to this point, Government participation in petroleum marketing was confined to 60% of Shell Nigeria's marketing unit, renamed the National Oil Marketing Co., which was acquired in April 1975. Mobil Oil Nigerian Ltd. and AGIP–Phillips marketing units were still owned 100% by their parent organizations.

Exploration.—A combination of Government price increases and decreased pumping allowances continued to have the effect of decreased investment in new exploration. The decline started in 1974 when the Federal Government first took majority ownership in the producing companies and drastically reduced allowable production levels. In 1975, taxes and royalties were increased, reducing profit margins; the posted price increases of 1976 cut profits even further. Major producing companies were slashing investment plans, selling off

[9] Petroleum Economist (London). Nigeria. V. 43, No. 7, July 1976, p. 277.
[10] Africa Report. Business Briefs. September–October 1976, p. 35.

equipment, and giving up exploration concessions. The number of drilling rigs operating in Nigeria declined from 29 in 1974 to 18 in 1975 and 15 in 1976. Although production had increased toward yearend 1976, there was widespread concern that exploration activity had been insufficient to safeguard production in future years. New financial incentives, expected to be announced at the beginning of 1977, would affect the petroleum profits tax (now 85%), royalty rates (now 20%), amortization and investment tax credits, and would promote increased investment.

A total of 21 exploratory wells were completed in 1976. The Shell BP consortium drilled eight exploratory wells four of which (Nembe Creek 6, Onite 1, Obigbo N–25, and Nembe Creek 17) were all shut in after oil was found. Alo 1 tested gas but was also shut in, and the other three holes were dry. NNOC embarked on its first wildcat drilling operation in August. Petty Ray and United Geophysical were hired by NNOC in October 1976 to do basic seismic studies in offshore areas held in national reserve. Gulf Oil Company (Nigeria) Ltd., Japan Petroleum Co. (Nigeria) Ltd., ELF, Phillips Petroleum, and NNOC made discoveries in 1976. A well that produced at a rate of 7,000 barrels per day was discovered in the Niger Delta by Nigerian AGIP Oil Co., a subsidiary of Italy's State-owned Ente Nazionale Idrocarburi (ENI) and operator for the Phillips Petroleum group. Called the Clough Creek No. 1, the well derived oil from four producing zones. Important reserves of gas were also discovered. NNOC was also a member of the AGIP–Phillips consortium.

Occidental Petroleum Nigeria relinquished its last prospecting license in Nigeria and wrote off a total investment of $33 million. Two offshore discoveries were made by the company, but neither was developed.

Refining.—The Government and Snam Progetti, part of the ENI group, signed a formal agreement for the design and construction of Nigeria's second oil refinery. Valued at $630 million, the refinery was to be built at Warri in Bendel State and was to have a 5-million-ton-per-year capacity. Engineering design work in Italy and site work at Warri were started, and the plant was scheduled to come onstream in 1978. Whessoe Ltd. signed a $5 million contract to build 39 steel storage tanks at the Warri refinery. Plans for the 5-million-ton-per-year refinery to be built at Kaduna were also firming up with selection of the King-Wilkinson Co. to provide project management and consultation services. The National Ports Authority was building a new oil jetty at Okirika, Rivers State, to facilitate the shipment of petroleum products from Port Harcourt refinery. The $21 million jetty was to replace the existing one damaged in 1975. Williams Brothers International Corp. won a contract to construct a 206-kilometer, 12-inch products pipeline from Port Harcourt via Aba to Enugu, and a 175-kilometer, 6-inch products line from Enugu to Makurdi, for completion in 1978. Construction was scheduled to begin by mid-1977.

The Mineral Industry of Norway

By Joseph B. Huvos [1]

In 1976, Norway was one of the world's major producers of aluminum, magnesium, and ferroalloys, thanks to its sizable hydroelectric resources. Development of North Sea oil made the country West Europe's largest oil producer. Norway's most important mineral products and approximate percentages of world output were as follows: Magnesium (30%), ilmenite (14%), aluminum (4.9%), nickel (4.5%), cobalt (2%), and zinc (1.2%). Production of other metals, minerals, and fuels, important only to the national economy, included copper, pig iron, steel, lead, vanadium, sand and gravel, cement, feldspar, fertilizer materials, nepheline syenite, quartzite, sulfuric acid, coal, and peat.

In 1976, Norway's gross national product (GNP) was about $33 billion.[2] Of this total the oil and coal industries contributed an estimated 4%, iron and steel 3%, nonferrous metals 4%, and nonmetallic minerals 2%. Out of a total industrial employment of 410,000 in 1976, mining employed about 12,000, including about 20% in oil and coal, the rest in ore mining. In the processing sector, oil and coal processing employed an estimated 2,500, mineral products 13,000, and metals 30,000.

Low product prices continued to prevail for most ores and minerals mined in Norway owing to weak demand in 1976. Aluminum was the only major metal that performed well in 1976.

There were a number of significant developments during the year. New aluminum reduction capacity came onstream at the Mosal Aluminium A/S reduction plant at Lista. New capacity came onstream also at the Titania A/S titanium dioxide plant at Kristiansand. Construction started for rebuilding two potlines at the Årdal reduction plant of Årdal og Sunndal Verk A/S (ASV). Construction continued at the magnesium chloride plant of Norsk Hydro A/S at Herøya; construction continued also at nine hydroelectric powerplant projects. Development continued at the Ekofisk, Statfjord, and Frigg oilfields in the North Sea where six new platforms were installed and two significant oil discoveries were made.

Plans were prepared to build a second ferrosilicon furnace at Orkla Industrier's Thamshamn plant.

Among government measures related to the mineral industry was the decision to continue government loans in support of the copper mining industry.

[1] Physical scientist, International Data and Analysis.

[2] U.S. Embassy, Oslo. State Department Airgram A-72, July 8, 1977, Enclosure p. 2.

Where necessary, values in Norwegian kroner (NKr) were converted to U.S. dollars at the rate of NKr 5.4565=US$1.00 for 1976 and NKr 5.2269=US$1.00 for 1975. Source for conversion rate was the International Monetary Fund.

PRODUCTION

The following tabulation shows production indices for various sectors of the mineral industry:

Industry sector	(1970=100) 1975	1976
Mining and quarrying:		
Coal mining	84	111
Metal mining	110	120
Other mining and quarrying [1]	114	112
Manufacturing:		
Iron, steel, ferroalloys	120	112
Nonferrous metals	110	122
Ceramics, glass, glasswares	105	112
Chemical raw materials	108	110
Refining of petroleum and coal	128	142
Electric power	135	142

[1] Includes production of crude oil and natural gas.

Source: Statistisk Sentralbura, Oslo. Statistisk Månedshefte, v. 95, No. 3, 1977, pp. 19–32.

Production of mineral commodities is shown in table 1. The tabulation below shows the major producers of commodities:

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	A/S Årdal og Sunndal Verk—smelters at Årdal, Sunndalsøra; government 75%, Alcan 25%	40
Do	Mosal Aluminium A/S—smelter at Mosjöen; Elkem-Spigerverket A/S 55%, Alcoa 45%	21
Do	Norsk Hydro A/S—smelter at Karmøy; government 51%	17
Coal	Store Norske Spitzbergen Kullkompani A/S—mines at Longyearbyen and Svea; government	100
Copper ore	A/S Sulitjelma Gruber—mine at Sulitjelma; Elkem-Spigerverket A/S–ESV	15
	Folldal Verk A/S—mines at Dovre and Kvalsund	14
	Grong Gruber A/S—mine at Røyrvik	14
Copper, refined	A/S Sulitjelma Gruber—smelter at Sulitjelma; Elkem-Spigerverket A/S	100
Ferroalloys	Elkem-Spigerverket A/S—plants at Svelgen, Kristiansand, Porksgrunn, Salten	30
Do	Electric Furnace Products Co. Ltd.—plant at Sauda; Union Carbide, United States	26
Do	Tinfos Järnverk A/S—plants at Notodden, Kvinesdal	25
Ilmenite	A/S Titania—mine at Telnes; NL Industries, United States	99
Iron ore	A/S Sydvaranger—mine at Sør-Varanger; government 51%	61
Do	Rana Gruber—mine at Rana; government 51%	33
Iron and steel	A/S Norsk Jernwerk—plant at Mo i Rana; government 51%	80
Lead and zinc ore	Bleikvassli Gruber A/S—mine at Hemnes; Frangel and Co. A/S	13
	Folldal Verk A/S—mine at Dovre	12
	Bergverkselskapet Nord Norge A/S—mine at Rana	12
Magnesium	Norsk Hydro A/S—smelter at Oslo; government 51%	100
Nickel and cobalt	Falconbridge Nikkelverk A/S—smelter at Kristiansand; Falconbridge Nickel Co., Ltd., Canada	100
Petroleum	Phillips Norway Group—North Sea Field at Ekofisk; Phillips Petroleum Co. of Norway 40%	100
Petroleum products	Norske Esso A/S—refinery at Slagen, Valloy; Standard Oil Co. of N.J	44
Do	Rafinor A/S & Co.—refinery at Mongstad; Norsk Hydro 30%, government 70%	32
Do	Norske Shell A/S—refineries at Sola and Valloy; Bataafse Petroleum, Netherlands	23
Pyrite	Folldal Verk A/S—mine at Dovre	43
Do	Elkem-Spigerverket A/S—mine at Skorovas Gruber, Namsskogan	25
Do	A/S Sulitjelma Gruber—mine at Fauske	20
Zinc, electrolytic	Det Norske Zinkompani A/S—smelter at Odda; Boliden AB, Sweden	100

Table 1.—Norway: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum metal:			
Primary ingot	648,213	594,828	608,129
Secondary ingot	13,126	10,335	e 12,000
Super pure	4,700	4,700	4,700
Cadmium smelter	90	47	80
Cobalt, metal	1,238	773	576
Copper:			
Mine output, metal content:			
In copper concentrate	20,336	26,647	31,505
In cupriferous pyrite	3,784	1,468	--
Total	24,120	28,115	31,505
Metal:			
Primary:			
Blister	31,737	26,349	23,813
Refined	24,807	19,675	16,822
Secondary	8,319	5,687	NA
Iron and steel:			
Iron ore and concentrate thousand tons	3,904	4,109	3,921
Roasted pyrite do	166	136	NA
Pig iron do	648	638	647
Ferroalloys:			
Ferrochrome do	31	27	27
Ferromanganese do	336	339	354
Ferrosilicon (75% basis) do	310	295	275
Ferrosilicomanganese do	187	163	173
Other do	10	31	9
Total do	874	855	838
Steel, crude do	956	907	898
Semimanufactures:			
Rolled do	685	673	666
Finished castings do	20	19	14
Lead, mine output, metal content	3,376	3,229	3,800
Magnesium metal, primary	39,795	38,337	38,808
Nickel:			
Concentrate, metal content	536	304	e 600
Metal, primary	43,224	37,056	32,684
Platinum-group metals (exports) troy ounces	30,833	46,779	48,676
Silicon, elemental (exports)	63,931	49,748	55,993
Titanium:			
Ilmenite concentrate	848,138	526,666	766,817
Dioxide e	18,000	23,000	25,000
Vanadium, mine output, metal content e	r 450	r 460	530
Zinc:			
Mine output, metal content	22,036	24,004	29,589
Metal, primary	72,434	60,891	62,853
NONMETALS			
Cement thousand tons	2,638	2,716	2,674
Feldspar, lump [1]	168,116	44,957	e 45,000
Fertilizer materials, manufactured:			
Nitrogenous:			
Gross weight thousand tons	922	993	NA
Elemental nitrogen content (total) do	635	495	473
Potassic do	4	5	NA
Compound and other do	1,251	1,187	NA
Ammonia do	936	764	NA
Graphite	9,698	8,925	8,358
Lime (quicklime and hydrated lime)	115,192	120,576	e 120,000
Mica (exports)	4,158	3,577	3,083
Olivine sand	315,358	309,233	NA
Pyrite and pyrrhotite:			
Gross weight	658,626	475,112	368,122
Sulfur content	314,199	232,549	e 177,000
Sodium and potassium compounds, n.e.s.:			
Caustic soda	73,155	72,873	74,193
Sodium carbonate	20,467	19,208	e 20,500
Stone:			
Dimension stone:			
Svenite (labrador)	56,458	NA	NA
Slate	72,930	65,202	NA
Crushed and broken stone:			
Dolomite:			
Ground	80,527	58,704	NA
Not further described	506,894	463,761	NA
Limestone thousand tons	5,174	5,337	NA

See footnotes at end of table.

Table 1.—Norway: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS—Continued			
Stone—Continued			
Crushed and broken stone—Continued			
Nepheline syenite	211,982	200,853	264,855
Quartz and quartzite	785,046	824,081	NA
Other ——thousand tons	[2] 877	[2] 1,100	NA
Sulfur, sulfuric acid (100%)	380,842	327,911	401,630
Talc, soapstone, steatite:			
Unground	52,883	46,978	NA
Other	60,143	58,015	NA
Total	113,026	104,993	e 100,000
Other nonmetals, n.e.s., oxides and hydroxides of magnesium, strontium and barium	27,251	19,715	NA
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades ——thousand tons	461	422	545
Coke, all grades ——do	313	265	287
Gas, manufactured ——million cubic feet	875	879	895
Peat:			
For agricultural use e	56,400	60,000	60,000
For fuel use e	1,200	1,200	1,100
Petroleum:			
Crude ——thousand 42-gallon barrels	12,707	68,900	101,900
Refinery products:			
Gasoline, motor ——do	6,001	7,702	8,915
Jet fuel ——do	1,392	1,703	1,715
Kerosine ——do	829	1,056	1,299
Distillate fuel oil ——do	16,114	19,862	25,566
Residual fuel oil ——do	15,058	17,306	17,534
Lubricants ——do	98	58	59
Other ——do	4,173	5,254	5,525
Refinery fuel and losses ——do	1,888	3,290	2,923
Total ——do	45,553	56,231	63,536

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Excludes nepheline syenite.

[2] Excludes a quantity of stone only reported volumetrically as: 1974—4,525,996 cubic meters; 1975—5,309,437 cubic meters; 1976—NA.

TRADE

The trade deficit of more than $3 billion in 1976 was mainly due to large investments in North Sea petroleum extraction and shipping and lagging foreign demand for major Norwegian products.

Metals (mainly aluminum, magnesium, and nickel), ferroalloys, rolled steel, and liquid fuels were again major export items in 1976, accounting for about half of the total value of all mineral commodity exports. Imports of liquid fuels, iron and steel, basic chemicals (mainly alumina and aluminum hydrate), and metallic ores (mainly nickel-copper matte) accounted for slightly more than one-quarter of all commodity imports in 1976.

Trade in mineral commodities in 1974 and 1975 is detailed in tables 2 and 3.

Table 2.—Norway: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Alumina	9	2	NA.
Metals including alloys:			
Scrap	12,805	8,472	West Germany 4,865; Sweden 1,854.
Unwrought	554,513	451,500	West Germany 131,547; United Kingdom 80,362; People's Republic of China 50,157.
Semimanufactures	40,688	37,143	United Kingdom 10,522; Sweden 9,548; Denmark 4,313.
Antimony	NA	NA	
Arsenic	NA	NA	
Cadmium	59	61	NA.
Chromium oxide and hydroxide	1	NA	
Cobalt	1,172	601	NA.
Copper:			
Ore and concentrate	52,964	83,270	West Germany 52,151; Sweden 28,520.
Oxide and hydroxide	2,173	2,154	Portugal 21; Nigeria 15; Taiwan 14.
Copper sulfate	NA	NA	
Metal including alloys:			
Scrap	2,152	1,360	Belgium-Luxembourg 550; West Germany 532.
Unwrought:			
Unrefined	6,290	6,969	All to West Germany.
Refined	25,777	18,363	United Kingdom 4,875; France 4,800; West Germany 2,578; Netherlands 1,989.
Semimanufactures	1,955	1,837	Sweden 1,273; Denmark 183.
Gold metal, unworked or partly worked troy ounces	2,154	2,025	West Germany 868; United Kingdom 482.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	2,657	3,154	West Germany 1,187; United Kingdom 1,085; Poland 496.
Roasted pyrite	152,508	113,194	Mainly to West Germany.
Metal:			
Scrap	34,446	19,536	Sweden 8,215; West Germany 7,794; Spain 3,505.
Pig iron including cast iron	121,301	100,863	United Kingdom 26,552; West Germany 19,934; Sweden 14,728.
Ferroalloys:			
Ferromanganese	309,365	256,639	United Kingdom 54,503; West Germany 51,603.
Other	527,408	385,969	United Kingdom 114,049; West Germany 104,801; United States 41,075.
Steel, primary forms	212,460	185,319	Netherlands 135,822; Denmark 17,281.
Semimanufactures:			
Bars, rods, angles, shapes, sections	193,475	217,809	United Kingdom 50,076; Sweden 39,150; Finland 28,335; West Germany 25,817.
Universals, plates, sheets	129,461	129,073	Sweden 50,095; United Kingdom 24,831; Denmark 15,991.
Hoop and strip	8,463	13,422	Sweden 10,806; Denmark 1,566.
Rails and accessories	975	877	Austria 274; West Germany 253; Sweden 161; Finland 139.
Wire	8,769	4,772	Portugal 705; United States 522; Switzerland 425.
Tubes, pipes, fittings	33,244	36,494	Sweden 15,212; Denmark 7,622; United Kingdom 5,441.
Castings and forgings, rough	14,002	12,822	Sweden 10,348.
Total	388,389	415,269	
Lead:			
Ore and concentrate	6,015	4,100	Netherlands 2,236; West Germany 1,864.
Oxides	26	14	Thailand 9.
Metal, including alloys:			
Scrap	4,748	4,744	Denmark 2,521; Sweden 1,938.
Unwrought	366	575	West Germany 289; Sweden 205.
Semimanufactures	164	6	Sweden 1.

See footnotes at end of table.

Table 2.—Norway: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Magnesium metal including alloys:			
Unwrought ----------value, thousands--	$45,311	$40,805	NA.
Wrought ----------	260	241	Netherlands 172; Sweden 57.
Manganese ore and concentrate ----------	1,831	2,730	United Kingdom 1,500; Sweden 1,230.
Mercury ----------76-pound flasks--	58	NA	
Molybdenum:			
Ore and concentrate ----------	NA	NA	
Metal including alloys, all forms --------	1	NA	
Nickel:			
Ore and concentrate ----------	13,515	6,885	All to Finland.
Matte, speiss and similar materials -----	NA	NA	
Metal including alloys:			
Scrap ----------	309	354	West Germany 274; Sweden 54.
Unwrought ----------	43,180	29,489	United States 13,091; West Germany 6,410.
Semimanufactures ----------	13	26	Sweden 15; Denmark 6.
Platinum-group metals and silver:			
Waste and sweepings --------kilograms--	57,051	48,652	West Germany 41,423; United Kingdom 6,797.
Metal including alloys:			
Platinum-group metals -troy ounces--	30,833	46,779	United States 25,142; Netherlands 8,809; West Germany 7,073.
Silver ----------do----	862,443	959,795	Sweden 851,994.
Rare-earth metals:			
Oxides ----------	8	10	United States 7; Japan 2.
Metal including alloys, all forms -value--	NA	NA	
Silicon, elemental ----------	63,931	49,748	U.S.S.R. 20,198; West Germany 10,825.
Tin metal including alloys:			
Scrap ----------	54	21	United Kingdom 13; Denmark 8.
Unwrought ----------	284	42	Sweden 17; Finland 12; United Kingdom 7; Denmark 6.
Semimanufactures ----------	8	9	All to Sweden.
Titanium:			
Ore and concentrate (ilmenite) ---------	776,814	534,606	NA.
Oxides ----------	900	962	Sweden 693; Denmark 140.
Tungsten metal including alloys, all forms value--	$3,339	$4,000	NA.
Uranium and thorium metal including alloys, all forms ----------do----	$28,882	$17,000	All to Denmark.
Zinc:			
Ore and concentrate ----------	20,488	14,765	Poland 7,510; Netherlands 7,255.
Oxide ----------	560	344	Sweden 225; Denmark 69; Malaysia 36.
Metal including alloys:			
Scrap ----------	371	114	Sweden 41; United Kingdom 37; Denmark 19; West Germany 17.
Blue powder ----------	459	2,838	NA.
Unwrought ----------	55,238	41,838	Sweden 21,879; United Kingdom 9,746; West Germany 6,084.
Semimanufactures ----------	873	388	Mainly to Sweden.
Other:			
Ash and residue containing nonferrous metals ----------	22,932	47,149	West Germany 24,940; United States 12,508.
Oxides, hydroxides and peroxides of metals, n.e.s ----------	2	1	NA.
Metal including alloys:			
Metalloids, n.e.s ----------	10	22	Netherlands 8; United States 8; Belgium-Luxembourg 2.
Pyrophoric alloys --value, thousands--	$3	$9	Mainly to Finland.
Base metals including alloys, all forms, n.e.s ----------	23	1	All to West Germany.
NONMETALS			
Abrasives, natural, n.e.s., grinding and polishing wheels and stones ----------	1,140	838	Sweden 230; Finland 166; Poland 147.
Asbestos ----------	73	5	NA.
Barite and witherite ----------	75	2,979	United Kingdom 2,450.
Boric oxide and acid ----------	NA	NA	
Cement, hydraulic ----------thousand tons--	876	981	Ghana 574; United States 311.
Chalk ----------	2	47	NA.

See footnotes at end of table.

Table 2.—Norway: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s	302	160	Egypt 49; Sweden 31.
Products:			
Refractory (including nonclay brick)	8,560	6,824	West Germany 4,163; Sweden 1,284.
Nonrefractory ---thousand tons	1,389	3,956	West Germany 3,473; France 330.
Diamond, gem, not set or strung value, thousands	$6	$8	NA.
Diatomite and other infusorial earth	15	16	NA.
Feldspar and related materials	325,683	300,773	West Germany 73,607; United Kingdom 57,103; Netherlands 53,444.
Fertilizer materials:			
Manufactured:			
Nitrogenous	811,049	874,002	Mainly to West Germany.
Phosphatic	25	3	NA.
Potassic	12	2	NA.
Other	788,552	[1] 101,456	NA.
Ammonia ---value, thousands	$12,350	$12,599	NA.
Graphite, natural	9,570	8,395	NA.
Gypsum and plasters	13,368	20,378	Ghana 19,289.
Lime	NA	100	All to Ivory Coast.
Mica crude including splittings and waste	4,158	3,577	West Germany 953; Netherlands 364.
Pigments, mineral, processed iron oxide	49	61	West Germany 22; Libya 20; Thailand 9.
Precious and semiprecious stones except diamond ---value, thousands	$7	$5	NA.
Pyrite, gross weight	410,573	231,251	West Germany 109,425; Sweden 82,874; France 26,766.
Salt	3,430	2,732	Iceland 1,050; Sweden 1,021; Canada 462.
Sodium and potassium compounds, n.e.s. value, thousands	$453	$335	NA.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Marble and other calcareous	3,697	1,589	West Germany 695; Italy 448.
Slate	45,876	44,018	Netherlands 21,589; West Germany 8,216; Denmark 5,762.
Other	100,557	84,989	France 27,269; West Germany 24,757; Italy 19,512.
Worked, all types	22	308	Sweden 253.
Dolomite	16	81,213	NA.
Gravel and crushed rock -thousand tons	1,180	1,129	West Germany 793; United Kingdom 127; Sweden 100.
Limestone (except dimension)	32,800	140,174	West Germany 101,178; Denmark 32,445.
Quartz and quartzite	4,548	3,641	West Germany 2,426; Denmark 777.
Sand, excluding metal bearing	3,007	2,858	Ivory Coast 351.
Sulfur:			
Elemental	68	22	NA.
Sulfur dioxide	777	1,377	Mainly to Sweden.
Sulfuric acid ---value, thousands	$2,532	$2,572	NA.
Talc, steatite, soapstone, pyrophyllite	66,883	55,318	Sweden 13,649; United Kingdom 10,737; West Germany 9,077.
Other nonmetals, n.e.s.:			
Crude	131	NA	
Slag, dross and similar waste, not metal bearing	2,842	12,800	Mainly to United States.
Oxides and hydroxides of magnesium, strontium and barium	NA	NA	
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	2,235	6,461	Denmark 5,864.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	652	45	NA.
Carbon black	6	8	NA.
Coal and coke, including briquets:			
Anthracite and bituminous coal	54,042	31,120	West Germany 25,641.
Coke and semicoke	70,840	14,940	Romania 12,560; Sweden 2,341.
Peat including peat briquets and litter	5	6	NA.

See footnotes at end of table.

Table 2.—Norway: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	13,874	54,397	United Kingdom 31,829; France 5,432.
Refinery products:			
Gasoline including natural ----do----	3,329	4,862	Sweden 2,023; United Kingdom 893; Denmark 808.
Kerosine and jet fuel ----------do----	93	605	All to Denmark.
Distillate fuel oil ----------do----	3,327	4,670	Sweden 2,223; Denmark 1,835.
Residual fuel oil ----------do----	8,012	8,225	Sweden 3,410; United Kingdom 1,918; Denmark 1,479; United States 1,099.
Lubricants ----------do----	77	10	Mainly to Sweden.
Mineral jelly and wax ----------do----	(2)	(2)	NA.
Other:			
Liquefied petroleum gas --do----	269	147	Sweden 70; Belgium-Luxembourg 23.
Nonlubricating oils, n.e.s -do----	12	70	All to Sweden.
Bitumen and other residues do----	(2)	(2)	NA.
Bituminous mixtures, n.e.s do----	(2)	(2)	NA.
Petroleum coke ----------do----	(2)	116	Netherlands 86; United Kingdom 30.
Pitch ----------do----	(2)	(2)	NA.
Total ----------do----	r 15,119	18,705	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ----------	20,434	17,309	Spain 7,507; Netherlands 4,191; Denmark 3,080; United Kingdom 2,486.

r Revised. NA Not available.
[1] Not reported in quantity in 1975.
[2] Less than ½ unit.

Table 3.—Norway: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite	6,576	6,143	Surinam 2,644.
Alumina	1,287,505	1,270,459	Jamaica 405,101; Surinam 236,835; Australia 198,248.
Metal, including alloys:			
Scrap	168	35	All from Iceland.
Unwrought	27,911	19,385	U.S.S.R. 6,435; Sweden 6,309; United Kingdom 2,102.
Semimanufactures	34,451	31,711	West Germany 14,084; Sweden 5,717; Finland 3,227.
Antimony metal, including alloys	35	52	People's Republic of China 15; Netherlands 10; Italy 10; Belgium-Luxembourg 10.
Arsenic trioxide, pentoxide and acid	80	68	All from Sweden.
Chromium:			
Chromite	86,204	84,501	Turkey 61,643; U.S.S.R. 10,823.
Oxide and hydroxide	160	224	Poland 125; West Germany 61.
Metal including alloys, all forms	3	NA	
Cobalt:			
Oxide and hydroxide	24	10	Belgium-Luxembourg 8; United Kingdom 2.
Metal including alloys, all forms	5	5	All from Belgium-Luxembourg.
Copper:			
Oxide and hydroxide	135	178	Finland 160.
Copper sulfate	1,479	1,277	U.S.S.R. 530; Belgium-Luxembourg 444; West Germany 136.
Metal including alloys:			
Scrap	285	1,121	United States 614; Belgium-Luxembourg 313.
Unwrought	1,703	3,050	United Kingdom 2,182; Belgium-Luxembourg 428.
Semimanufactures	30,005	27,273	Sweden 9,317; United Kingdom 5,739; West Germany 5,456.
Gold metal, worked or partly worked troy ounces	26,878	20,930	West Germany 10,256; United Kingdom 7,523.
Iron and steel:			
Ore and concentrate	13,773	37,766	Sweden 29,097; U.S.S.R. 8,573.
Scrap	50,995	53,338	West Germany 17,035; Netherlands 11,323; Denmark 9,341.
Pig iron, ferroalloys and similar materials	33,050	16,017	West Germany 9,748; United Kingdom 2,678; Sweden 1,540.
Steel, primary forms	167,625	131,898	Netherlands 103,465; West Germany 8,400; United Kingdom 7,587.
Semimanufactures:			
Bars, rods, angles, shapes, sections	398,311	326,590	West Germany 103,203; France 46,049; Sweden 39,375.
Universals, plates, sheets	897,122	711,959	West Germany 178,056; Japan 157,703; Sweden 81,083.
Hoop and strip	54,553	39,035	West Germany 15,291; Belgium-Luxembourg 7,147; France 5,361; Sweden 5,296.
Rails and accessories	11,342	13,210	Sweden 9,200; West Germany 2,325.
Wire	13,929	12,410	Sweden 3,463; Belgium-Luxembourg 3,308; United Kingdom 3,172; West Germany 1,271.
Tubes, pipes, fittings	178,553	177,344	West Germany 63,381; United Kingdom 26,135; Japan 20,996; France 20,336.
Castings and forgings, rough	1,874	3,548	Denmark 1,537; Sweden 558; United Kingdom 379.
Total	1,555,684	1,284,096	
Lead:			
Oxides	932	615	United Kingdom 372; West Germany 138; Sweden 80.
Metal, including alloys:			
Scrap	68	38	United Kingdom 17.
Unwrought	13,703	12,871	United Kingdom 6,289; Sweden 2,505; Denmark 1,934; Republic of South Africa 1,875.
Semimanufactures	1,247	1,219	Netherlands 516; West Germany 368; Belgium-Luxembourg 229.

See footnotes at end of table.

Table 3.—Norway: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Magnesium metal including alloys:			
Unwrought ——value, thousands	$2,228	$289	Netherlands $2.
Wrought	28	20	Netherlands 8; United Kingdom 4; Italy 2; United States 2.
Manganese:			
Ore and concentrate	1,033,047	1,073,000	Republic of South Africa 340,569; Brazil 248,413; Australia 97,296.
Oxides	967	553	People's Republic of China 520.
Metal including alloys, all forms	934	847	Republic of South Africa 780.
Mercury ——76-pound flasks	138	9	All from People's Republic of China.
Molybdenum metal including alloys, all forms	NA	3	Austria 2.
Nickel:			
Matte, speiss, similar materials	93,243	79,337	Canada 70,538.
Metal including alloys:			
Scrap	NA	NA	
Unwrought	718	103	Canada 63.
Semimanufactures	302	352	United Kingdom 144; West Germany 82; United States 60; Sweden 43.
Platinum-group metals and silver:			
Waste and sweepings ——kilograms	14,205	13,775	Sweden 12,151.
Metal including alloys:			
Platinum group ——troy ounces	10,513	3,376	Switzerland 1,222; West Germany 1,190; United Kingdom 739.
Silver ——thousand troy ounces	3,397	2,753	United Kingdom 1,318; West Germany 1,029.
Silicon, elemental ——value	(1)	$111	Denmark $59; Republic of South Africa $28; France $24.
Tantalum metal, including alloys, all forms ——do	$902	$2	NA.
Tin:			
Oxide	1	11	United Kingdom 10.
Metal, including alloys:			
Scrap	72	49	Sweden 39.
Unwrought	795	787	United Kingdom 489; Denmark 111.
Semimanufactures	527	401	United Kingdom 268; West Germany 82.
Titanium:			
Ore and concentrate	75	80	All from Australia.
Oxide	806	282	West Germany 143.
Tungsten metal, including alloys, all forms	1	2	United States 1.
Uranium and thorium:			
Oxides, including rare-earth oxides	27	107	United States 54; West Germany 25; Japan 18.
Metals, including alloys, all forms value, thousands	NA	NA	
Zinc:			
Ore and concentrate	86,805	61,983	Sweden 43,351; United States 10,158.
Oxide and pentoxide	2,337	1,479	East Germany 938; West Germany 198; Sweden 187.
Metal, including alloys:			
Scrap	2,279	2,693	Sweden 1,988; Denmark 699.
Blue powder	2,114	1,024	France 926.
Unwrought	3,549	4,140	Poland 1,119.
Semimanufactures	1,323	1,263	France 732; West Germany 188; United Kingdom 172.
Other:			
Ore and concentrate	2,120	298	Australia 277.
Ash and residue containing nonferrous metals	2,434	25,571	Sweden 25,511.
Oxides, hydroxides, peroxides of metals, n.e.s	20	10	United Kingdom 8.
Metals, including alloys, all forms:			
Metalloids	20	5	All from Sweden.
Alkali, alkaline earth, rare-earth metals	75	72	United Kingdom 59; Austria 10.
Pyrophoric alloys	3	5	United Kingdom 4; United States 1.
Base metals, including alloys, all forms, n.e.s	67	835	Netherlands 760.

See footnotes at end of table.

Table 3.—Norway: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS			
Abrasives:			
Pumice, emery, natural corundum	7,636	5,004	West Germany 4,833
Dust and powder of natural or synthetic precious or semiprecious stones, except diamond _kilograms	61	21	Netherlands 13.
Grinding and polishing wheels and stones	979	1,070	Austria 291; United States 216; Sweden 205; West Germany 115.
Asbestos	5,892	5,629	West Germany 2,102; Canada 1,274; U.S.S.R. 1,198; Republic of South Africa 788.
Barite and witherite	60,387	75,914	United Kingdom 26,539; Netherlands 25,664; France 8,688.
Boron materials:			
Crude natural borates	4,520	5,509	United States 3,925; Netherlands 709.
Oxide and acid	113	298	United States 230; France 29.
Cement, hydraulic	5,058	5,420	Denmark 2,079; United Kingdom 1,840.
Chalk	8,564	7,918	Denmark 3,591; Sweden 2,167; France 1,332.
Clays and clay products:			
Crude clays:			
Fuller's earth, dinas, chamotte	914	344	United States 171; West Germany 101; United Kingdom 36.
Kaolin	86,521	77,800	United Kingdom 75,212.
Other	63,894	71,261	Greece 26,121; United Kingdom 22,376.
Products:			
Refractory	32,953	34,515	West Germany 8,392; Sweden 7,457; United Kingdom 7,134; Austria 6,183.
Nonrefractory _value	$7,104	$7,475	Netherlands $2,113; West Germany $1,724; Sweden $1,673.
Cryolite and chiolite	4,700	2,145	All from Denmark.
Diamond:			
Gem, not set or strung thousand carats	10	25	Japan 10; Belgium-Luxembourg 5; United Kingdom 5.
Industrial _value	$1,444	$9,000	NA.
Diatomite and other infusorial earth	1,422	1,292	United States 479; Iceland 389; Denmark 189.
Feldspar	30	NA	
Fertilizer materials:			
Crude:			
Phosphatic	418,001	414,490	U.S.S.R. 221,098; United States 75,258; Morocco 48,126; Israel 41,915.
Potassic	NA	NA	
Manufactured:			
Nitrogenous	2,060	936	West Germany 670.
Phosphatic	16,411	13,140	Sweden 11,008; Belgium-Luxembourg 1,730.
Potassic	268,769	269,520	France 104,032; West Germany 73,521; Israel 39,571.
Other	8,526	7,319	Sweden 7,180.
Ammonia	35,910	11,550	Denmark 6,087; United Kingdom 2,862; Netherlands 2,597.
Fluorspar	41,173	46,180	United Kingdom 24,508; Spain 9,960; East Germany 6,398; West Germany 4,736.
Graphite, natural	493	892	United Kingdom 700; Sweden 166.
Gypsum and plasters	241,729	214,941	France 101,685; Poland 84,743.
Lime	15,134	14,188	Denmark 13,465.
Magnesite	5,310	4,138	Czechoslovakia 2,450; People's Republic of China 974; Austria 519.
Mica, worked and unworked, all forms	4,098	3,895	India 3,390.
Pigments, mineral:			
Natural, crude	109	87	West Germany 55; Denmark 17.
Iron oxide processed	3,785	1,803	West Germany 1,738.

See footnotes at end of table.

Table 3.—Norway: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Precious and semiprecious stones, except diamond, including synthetic stone ——kilograms	538	1,132	West Germany 637; Brazil 342.
Salt and brine	336,299	313,300	Netherlands 125,545; Tunisia 65,985; United Kingdom 37,876; West Germany 32,488.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	51,162	15,274	Netherlands 9,574; Belgium-Luxembourg 3,586.
Caustic potash, sodic and potassic peroxides	890	904	Sweden 720; France 134.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	389	481	Sweden 423.
Slate	2,555	2,515	Sweden 2,161; East Germany 354.
Other	21,653	10,752	Sweden 8,085; Portugal 1,172; Denmark 1,154.
Worked, all types	7,203	3,776	Portugal 2,132; Sweden 819.
Dolomite	3,341	3,342	Sweden 1,753; West Germany 1,015; United Kingdom 450.
Flint	1,048	569	Denmark 540.
Gravel and crushed rock	46,222	70,788	Sweden 68,670.
Limestone	261,007	249,519	United Kingdom 236,989.
Quartz and quartzite	302,116	308,599	Spain 210,044; Sweden 48,026; Portugal 46,446.
Sand, excluding metal-bearing	206,046	194,811	Belgium-Luxembourg 107,866; Sweden 57,061.
Sulfur:			
Elemental	22,081	19,360	Poland 15,121.
Sulfur dioxide	11,502	11,339	All from Sweden.
Sulfuric acid	57,746	813	Sweden 651; Denmark 93.
Talc, steatite, soapstone, pyrophyllite	3,352	3,890	India 1,662; Spain 1,000; People's Republic of China 415.
Other, n.e.s.:			
Crude	71,802	74,106	West Germany 68,391.
Slag, dross and similar waste, not metal bearing	49,140	48,463	Sweden 39,714.
Oxides and hydroxides of magnesium, strontium, barium	1,664	584	United Kingdom 290; France 161; Sweden 68.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	10,963	9,853	Sweden 4,821; Belgium-Luxembourg 1,263; Netherlands 1,139.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	266	500	United States 246; Denmark 140; Sweden 55.
Carbon black	5,163	4,914	Sweden 2,760; West Germany 1,566.
Coal, all grades, including briquets thousand tons	547	457	Poland 198; United Kingdom 126; United States 59.
Coke, all types ——do	706	647	United Kingdom 454; West Germany 85; France 68.
Peat, including peat briquets and litter	7,037	7,300	Sweden 6,109.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	47,103	40,222	Iran 14,798; United Arab Emirates 6,461; Nigeria 5,656.
Refinery products:			
Gasoline including natural ——do	6,333	5,236	U.S.S.R. 927; Belgium-Luxembourg 833; United Kingdom 697; Netherlands 527.
Kerosine and jet fuel ——do	2,806	2,945	United Kingdom 705; Belgium-Luxembourg 659; Netherlands 530; West Germany 317.
Distillate fuel oil ——do	10,071	7,826	United Kingdom 2,201; Belgium-Luxembourg 1,611; Netherlands 1,186.
Residual fuel oil ——do	4,649	2,158	U.S.S.R. 380; Belgium-Luxembourg 280.
Lubricants ——do	511	433	Sweden 127; United Kingdom 100; Denmark 93.
Mineral jelly and wax ——do	79	63	West Germany 31; U.S.S.R. 8.

See footnotes at end of table.

Table 3.—Norway: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum—Continued			
Refinery products—Continued			
Other:			
Liquefied petroleum gas thousand 42-gallon barrels	116	121	Sweden 81; Netherlands 23.
Nonlubricating oil, n.e.s do	35	98	United Kingdom 28; West Germany 21; France 21; Sweden 14; Belgium-Luxembourg 14.
Bitumen and other residues do	1,139	970	Netherlands 358; Belgium-Luxembourg 242; West Germany 152; Sweden 121.
Bituminous mixtures, n.e.s do	12	18	United Kingdom 6.
Petroleum coke do	1,881	1,755	United States 1,458; United Kingdom 215.
Pitch and pitch coke do	559	534	United Kingdom 347; West Germany 187.
Total do	28,191	22,157	
Mineral tars and other coal-, petroleum-, or gas-derived crude chemicals	25,538	28,867	Poland 2,854.

NA Not available.
[1] Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—The recovery of the international aluminum market in 1976 resulted in increased exports, increased domestic consumption, and lower stocks, although the price of aluminum was still somewhat depressed.

In 1976, Mosal Aluminium A/S, commissioned the new (No. 3) 27,000-ton-per-year potroom at its Lista Island, Vest Agder Province, reduction plant, bringing the plant's capacity to 82,000 tons per year. ASV started rebuilding two potlines at its Årdal, Sognefjord, reduction plant, to add 32,000 tons per year to its present capacity. The State-owned Norsk Hydro, has taken over the majority of Norwegian interests (19.4%) in Sør Norge Aluminium A/S, Husnes, leaving 75% to Schweizerische Aluminium AG (Alusuisse), Switzerland.[3] Norsk Hydro decided to proceed with a 75,000-ton-per-year expansion of its Karmøy, Rogaland Province, reduction plant.

ASV decided to proceed with a feasibility study of a partnership in an alumina project in Hamburg, West Germany. Involved is a $180 million; 450,000-ton-per-year extension of an existing 600,000-ton-per-year plant jointly owned by Reynolds Metals, (United States) and Vereinigte Aluminium Werke (West Germany).

Anortal, a company jointly owned by ASV and Elkem-Spigerverket A/S, operated a pilot plant for processing anorthosite with 30% Al_2O_3 into alumina, and had rights to exploit deposits in Aurland and Voss municipalities in West Norway.

Five companies operating eight primary aluminum plants in 1976, with a total capacity of about 725,000 tons per year, are shown in table 4.

Norwegian companies give high priority to securing raw materials needed for industry. ASV and Norsk Hydro each have 5% interest in the Trombetas, Brasil, bauxite mine of Mineraçao Rio do Norte S.A., and have a contract for the delivery of 350,000 tons per year of bauxite.

Copper, Lead, and Zinc.—For the second consecutive year, the Government extended loans up to $9.5 million to the copper mining industry to ease financial difficulties caused by the depressed copper market. The interest-free loans are to be repaid over a period of 3 years, starting in 1981.

Orkla Industrier A/S decided to separate its Løkken copper mine, east of Trondheim, from its other operations and to incorporate it into a new company jointly owned by Orkla and Sydvaranger A/S. Up to $58

[3] Aluminium. V. 53, No. 1, January 1977, p. 49.

Table 4.—Norwegian producers of primary aluminum

Company and plant location	Capacity, thousand tons yearend 1976	Ownership
Årdal og Sunndal Verk, Oslo:		
Årdal, Sognefjord	175	Government (75%), Alcan Aluminium Ltd., Canada (25%).
Sunndalsøra, Tingvollfjord	120	
Høyanger, Sognefjord	30	
Mosal Aluminium A/S, Oslo:		
Mosjøen, Vejsnafjord	100	Elkem-Spigerverket A/S, Oslo (55%), Aluminum Co. of America (Alcoa), United States (45%).
Lista Island	80	
Norsk Hydro A/S, Oslo:		
Karmøy Island	120	Government (51%).
Sør Norge Aluminium A/S:		
Husnes, Hardangerfjord	75	Alusuisse (75%).
DNN Aluminium A/S:		
Tyssedal, Sørfjord, Odda	25	Alcoa (50%), British Aluminium Ltd., United Kingdom (50%).

million is to be invested, part of it into the Løkken mine.

A/S Sulitjelma Gruber plans to increase production at its Fauske mines from about 8,000 tons of copper in 1976 to 10,000 tons in 1978. In the meantime, the capacity of the company's Sulitjelma smelter is to be raised to 25,000 tons of blister copper per year.[4] At present, some blister is refined at the Falconbridge Nikkelverk A/S, Kristiansand electrolytic refinery. Surplus Norwegian copper concentrates and all lead concentrates are exported because there is limited copper smelter capacity and no lead smelter in the country.

Det Norske Zinkkompani published plans to invest $86 million over a period of 5 years to raise electrolytic zinc capacity at its Odda plant, southeast of Bergen, from 80,000 tons to 130,000 tons per year.[5] About two-thirds of the zinc concentrates used at the plant were imported. Norway's 12 small complex sulfide ore mines were operated by 10 independent companies. The sulfide ores contained mostly copper, lead, zinc, and pyrites. The more important copper mines of the country were A/S Sulitjelma Gruber's Fauske mine east of Bodö, which produced also lead and pyrite concentrates; Folldal Verk A/S's Dovre and Kvalsund mines, producing zinc and pyrite concentrates; Grong Gruber A/S's Røyrvik mine near the Swedish border northeast of Grong, which produced zinc concentrates; and Orkla Industrier A/S's Meldal mine at Løkken south of Trondheim, producing zinc and pyrite concentrates.

Iron Ore.—Continued weakness in foreign markets affected iron pellet and concentrate exports, and production.

Of five Norwegian iron ore mines three were Government-owned, the others belonged to Elkem-Spigerverket A/S.

1. Government-owned A/S Sydvaranger, Oslo, mined a taconite deposit 8 kilometers from Kirkenes by open pit methods. Concentrates were pelletized in a 3-million-ton-per-year pelletizing plant.

2. The Government-owned A/S Norsk Jernwerk's Rana Gruber located at Rana, near Mo, produced magnetite-hematite ore from an open-cast mine. About 10 million tons of 35% ore was processed into a 65% concentrate making Norsk Jernwerk self-sufficient in iron ore.

3. Government-owned Fosdalen Bergwerks A/S mined iron ore from which about 500,000 tons of magnetite concentrate and some pyrite and chalcocite concentrates was produced.

4. Elkem-Spigerverket's Rødsand Gruber A/S produced raw ores at Nesset, containing 0.31% V_2O_5 and 30% iron, which were processed into about 100,000 tons of magnetite concentrate with 64% Fe. The company's Swelgen, Bremanger, smelter on Norway's west coast produced ferro-vanadium and vanadium-titanium pig iron.

5. Elkem-Spigerverket's Titania A/S produced about 50,000 tons of byproduct iron concentrates, mostly magnetite, at its Sokndal mine in south Norway.

Iron, Steel, and Ferroalloys.—As part of a $50 million investment plan, a second ferrosilicon furnace is to be built at Orkla Industrier's Thamshamn plant near Trond-

[4] International Wrought Copper Council. Survey of Planned Increases in World Copper Mine, Smelter and Refining Capacities 1974–1980. London, 1976, p. 33.

[5] Glückauf. Mar. 18, 1976, p. 275.

heim, bringing ferrosilicon capacity from 22,000 to 60,000 tons per year. The plant, together with a nearby mine, is to be separated from Orkla and run independently under the joint ownership of Orkla and Elkem-Spigerverket.

Norwegian iron ore and natural gas are to be used at a 1.2-million-ton-per-year three-unit Midrex plant to be built at the Emden, West Germany, terminal of the Ekofisk natural gas pipeline. A/S Sydvaranger signed a preliminary agreement with Korf Stahl AG, Baden-Baden, to form a new jointly owned company, Norddeutsche Ferrowerke GmbH, to operate the new plant.

Norway had three major steelmaking companies. Wholly Government-owned Norsk Jernwerk used domestic ores at the Mo i Rana plant with a 600,000-ton-per-year capacity. Elkem-Spigerverket's Nydalen, Oslo, plant and Stavanger Stal's Jorpeland, Stavanger, plant had an aggregate capacity of about 400,000 tons.

About 9 companies produced ferroalloys at 15 locations. The largest among them was Elkem-Spigerverket A/S, with capacity at Svelgen, Kristiansand (south coast), Porksgrunn (south coast), and Salten (Bodö) totaling 332,000 tons per year. Others were Electric Products Co. Sauda (280,000 tons), and Tinfos Järnverk A/S at Notodden and Kvinesdal (270,000).

Magnesium.—Work continued on Norsk Hydro's 50,000-ton-per-year anhydrous magnesium chloride plant at Herøya, South Telemark Province, where production was scheduled to begin in 1977. The entire output of the plant is to be used for producing 15,000 tons per year of magnesium metal, with 40,000 tons of byproduct chlorine to be used at the company's Ranes petrochemical complex.

Norsk Hydro remained Norway's only magnesium producer at its 40,000-ton-per-year Porksgrunn plant at Herøya. In addition, the company produced 30,000 tons of magnesium oxide. Dolomite used as a raw material comes mostly from the north of Norway. Major producers were A/S Norvegian Talc from its Hammerfall mine near Bodö and Franzefoss Bruk, with a mine at Ballangen near Narvik.

Nickel, Cobalt, and Platinum-Group Metals.—The low operating rates of 1975 were maintained in 1976 at Falconbridge Nikkelverk's Kristiansand refinery, although export shipments were increased, partly from existing stocks. Falconbridge, a subsidiary of Falconbridge Nickel Co. Ltd. of Canada, remained Norway's only producer of nickel, cobalt, and platinum-group metals. Production was based mainly on nickel-copper matte imported from Canada, and smaller amounts of domestic sulfide concentrates produced as a byproduct of processing ilmenite ores at the Tellnes mine near Sokndal, south Norway.

Titanium.—Ilmenite production capability increased substantially due to new capacity commissioned in 1975 at the Sokndal mine of Titania, a subsidiary of NL Industries Inc. (United States) near Dalane, south Norway. Titania produced more than 99% of the country's ilmenite; the rest came from the Nesset mine of Rødsand Gruber A/S, on the Tingvollfjorden. Titania's Kristiansand titanium dioxide plant south of Oslo was expanded to 25,000 tons per year, leaving four-fifths of the domestically produced ilmenite ore for export.

NONMETALS

Cement.—Cement production and exports decreased slightly. A/S Norcem remained the country's only producer with plants at Brevik and Slemmestad in the south and Kjøpsvik in the north on the Finnish border.

Fertilizer Materials.—Increased inland consumption could not make up for decreased exports, and nitrogenous fertilizer production had to be further curtailed.

Norsk Hydro remained Norway's main producer of fertilizer materials. The company produced about 700 tons of ammonia per day, partly from electrolytic hydrogen at its Glomfjord plant near Mo.

Pyrite and Sulfur.—Production of pyrite concentrate decreased substantially, as traditional markets switched increasingly to less expensive native sulfur. A large share of domestic pyrite output was processed domestically for increased base-metal concentrate recovery. In 1976, 8 of the country's 12 base-metal sulfide mines produced some pyrites.

Other Nonmetallic Minerals.—Increasing amounts of nepheline syenite were produced by Elkem-Spigerverket A/S-Norsk Nefelin at an underground mine at Sternøy, Altafjord, in Finnmark. A/S Olivin produced about 170,000 tons of refractory sand and brick. KS Norddal Olivin A/S & Co.

produced about 90,000 tons of olivine. A/S Norwegian Talc had a 100,000-ton-per-year capacity at its Knarrevik mill near Bergen for finely ground dolomite, talc, and mica. The company produced dolomite at a rate of 400,000 tons per year at its Hammerfall mine near Bodö, about 15,000 tons of mica schist giving 3,000 to 5,000 tons of mica concentrate at Rendalsvik north of Mo, and up to 40,000 tons of talc at Altermark on the Ranafjord. KS Norfloat A/S & Co. produced flotation feldspar and quartz at Lillesand on the south coast. A/S Skaland Grafitverk produced a flotation graphite concentrate on Senja Island south of Tromsö. There were also several anorthosite quarries in the Egersund area in the south and many limestone quarries, mostly for cement, in various areas of the country, producing about 5 million tons per year of limestone.

MINERAL FUELS

Steadily growing North Sea oil and sizable hydroelectric power provided the bulk of Norway's energy supply in 1976. About three-quarters consisted of petroleum and petroleum products, one-fifth domestic hydroelectric power, the rest coal. The country was also increasingly a net oil exporter.

After a temporary decrease in 1974, energy consumption increased again in 1976 for the second consecutive year, exceeding previous highs. Norway's supply and apparent consumption of fuels and power in 1975 and 1976 are shown in table 5.

Coal and Coke.—In 1976, the Government-controlled Norske Spitzbergen Kulkompani A/S increased production at its Longyearbyen mine on Spitzbergen Island and continued to develop the Svea coalfield near Van Mijeffjorden. Coal was shipped mostly to the Mo i Rana steel plant and some ferroalloy plants. The U.S.S.R. continued to mine about 450,000 tons of coal per year at Barentsburg and Piramiden, both near Longyearbyen.

Hydroelectric Power.—Norway supplied all domestic electric power needs from hydroelectric stations. Construction continued on nine hydroelectric powerplants across the country, including the 1,200-megawatt Kvildal plant and the 640-megawatt Saurdal plant in the southwest.[6] Twenty-five more plants were in the planning stage. Production is to reach 86 million kilowatt-hours in 1980 and 102 million kilowatt-hours in 1985. In case of dry weather, 5 million kilowatt-hours are to be imported and an equal amount produced in thermal plants; nuclear plants are under consideration only for 1985.

Petroleum and Natural Gas.— *Production and Exploration.*—In 1976, development work continued at a moderate rate in the North Sea at the Ekofisk, Statfjord, and Frigg oilfields. Operators in the North Sea drilled 25 wildcat holes in 1976, and were expected to drill the same number of holes during 1977. In all these operations,

[6] Energiewirtschaftliche Tagesfragen (Frankfurt). V. 26, No. 11, November 1976, p. 657.

Table 5.—Norway: Supply and apparent consumption of fuels and power in 1975 and 1976

(Million tons of standard coal equivalent [1])

Year	Total primary energy	Coal	Crude oil and petroleum products	Hydroelectric power [2]
1975: [3]				
Production	24.1	0.4	14.0	9.7
Imports	14.5	1.3	13.2	--
Exports	16.2	--	15.5	.7
Apparent consumption	22.4	1.7	11.7	9.0
1976: [3]				
Production	31.0	.5	20.4	10.1
Imports	16.9	1.1	15.8	--
Exports	24.8	.1	23.9	.8
Apparent consumption	23.1	1.5	12.3	9.3

[1] 1 ton of standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Secondary included in trade.
[3] Primary energy only.

Source: Statistisk Månedshefte. Central Bureau of Statistics, Oslo, Norway, 1976, No. 12. Månedsstatistikk Over Utenriks-Handelen, Statistisk Sentralbura, Oslo, Norway, 1977.

the Norwegian Government exercised its control through Den Norske Stats Oljeslskap A.S. (Statoil), the State oil company, which is to have a controlling interest in all new North Sea blocs. Detailed seismic work was performed by Aratoil and other Norwegian companies in the offshore areas of More, Trondelag, Troms, and Finnmark. Sediments in these areas were said to be up to 4,000 meters thick, or 10 times thicker than oil-bearing sediments south of the 62d parallel.[7]

The Norwegian Government ordered offshore personnel to be housed on platforms separate from production platforms. This measure necessitated profound changes in future oilfield development plans, and has also caused a temporary standstill in Statfjord developments, where Mobil, an operator with 15% interest in the field (Statoil 44%), considered scrapping plans for the $1 billion Statfjord B production platform in favor of a series of smaller platforms, which would add $100 million to development costs.

At yearend, Norwegian oil reserves in the North Sea totaled 760 million tons and natural gas reserves, 650 billion cubic meters.[8]

Plans were made at the Statfjord oilfield to tow out the $270 million A platform in May 1977. Plans for the B platform were delayed. The oilfield in blocks 33/9 and 12 was to begin production in 1979 at a rate of 3 million tons per year. Original plans for Statfjord A, B, and C platforms called for a peak production of 45 million tons per year, with development costing $2.5 billion. Statoil was in charge of preparing a proposal for a 36-inch crude oil and a gas pipeline leading to the Norwegian mainland through the Norwegian trench, up to 300 meters deep.

The last Ekofisk platforms were installed in summer at the Edfisk, Albuskjell, and Edda Fields. Development drilling began at the Cod platform in December. Production from the block 2/4 area complex was at a rate of 18 million tons at yearend. The West Ekofisk and Cod Fields were to start production early in 1977, when natural gas liquids facilities were to be completed for separating the liquid from the gas for shipment of the liquid to England.

The Phillips Norway Group's 25-billion-cubic-meter-per-year, 440-kilometer-long pipeline from Ekofisk to Emden, West Germany, was ready for operation but lay idle because of the Danish Government's requirement that the line be buried 10 meters deep under the seabed.

Three platforms were installed during the summer months in the Frigg Field in block 24/11. Elf Norge A/S, the operator, planned to start production at a rate of 20 billion cubic meters per year. The gas was to be carried to St. Fergus in Scotland via twin 32-inch pipelines 350 kilometers long completed in 1975. There are to be eventually five platforms in the field.

The Amoco Norway Oil Co. and Noco-Norwegian Oil Consortium A/S & Co. group filed a development plan for its Hod-Valhall complex in block 2/8 near Ekofisk. A $550 million steel platform is to be installed for production in 1980.

Esso Exploration Norway Inc. was considering exploitation of its Odin gasfield and A/S Norske Shell was preparing plans for developing the Albuskjell Field in blocks 1/6 and 2/4.

In 1976, two major discoveries were Conoco Norway Inc., 960-ton-per-day oil strike in block 7/12 near Cod and Mobil Oil A/S Norge, 1,800-ton-per-day strike in block 33/9 near Statfjord. Both were Jurassic and both were through ¾-inch chokes.

The West German and Swedish Governments were actively seeking long-term agreements with the Norwegian Government for the purchase of its Government-owned oil and gas. Denmark has also expressed interest in Norwegian gas. Norway suggested that oil and gas found off north Norway might be produced and refined in a cooperative Nordic development effort; Finland, Iceland, and others expressed interest in the project.

Refining.—The country's main refineries included A/S Norske Esso's 5.5-million-ton Slagen and 0.2-million-ton Valloy refineries, Raffinor A/S & Co.'s 4-million-ton-per-year Mongstad refinery in Karmøy, and Norske Shell's 2.75-million-ton-per-year Sola, and 0.15-million-ton-per-year Valloy refineries. Statoil also had a 33% interest in the Bamble petrochemical project under construction, in which Norske Hydro had 51% and Saga Petroleum A/S Co. 16% interest.

[7] Erdöl und Kohle. May 1, 1977, pp. 198–199.
[8] International Petroleum Encyclopedia. Norway. V. 10, 1977, p. 155.

The Mineral Industry of Pakistan

By David E. Morse [1]

Mineral development in Pakistan has lagged behind the rest of the economy because of low interest by private investors and insufficient Government funding for exploration. The index of mineral production has increased only slightly (10.3%) since fiscal 1969–70.[2] The Government has attempted to strengthen the mineral position of the country through several Government agencies. The Pakistan Mineral Development Corp. (PMDC) was responsible for the exploration and development of minerals. The Resource Development Corp. (RDC) was concerned exclusively with the development of the Saindak copper deposits. The Oil and Gas Development Corp. (OGDC) was responsible for the exploration and development of oil and gas resources in Pakistan. The Geologic Survey of Pakistan handled geological studies, mapping, and nonpetroleum exploration. The Board for Mineral Coordination was established to coordinate the activities of the provincial mineral development agencies: Baluchistan Development Authority, Punjab Mineral Development Corp., and Sarhad Development Board (of the North-West Frontier Province).

The Government has steadily increased allocations for mineral exploration in recent years, but the allocations have been restrained because of the country's economic difficulties and the swelling trade deficit. A Canadian-assisted aeromagnetic survey of 84,000 square kilometers in parts of Baluchistan was underway in 1976. Mineral exploration projects investigated copper mineralization in the Chāgai and Khuzdār Districts of Baluchistan, phosphate rock deposits in the Hazāra District and Khyber Agency of North-West Frontier Province, cement and ceramic raw materials in all provinces, and sulfide mineralization and pegmatites at Azād Kashmīr.

Pakistan's economy continued to grow at a modest rate, with the gross national product (GNP) increasing to $12,250 million [3] in fiscal 1975–76, about 5% above that of fiscal 1974–75. Industrial production for the same period grew at a rate of 1%. The public sector dominated the country's industries during the year. The climate for private investment was depressed, and private entrepreneurs were cautious because of past nationalizations. The Government continued to welcome foreign investors, particularly those who could provide advanced technology, capital input, and markets for export.

PRODUCTION

The mineral output of Pakistan exhibited many minor changes in 1976, but the overall results remained similar to those of 1974 and 1975. Production of natural gas from the Sui and Mari Fields increased slightly to meet domestic demand. Crude oil production increased 17% over that of 1975, but it was 14% below the 1974 output. Pakistan produced significant quantities of limestone and other stone, rock salt, coal, gypsum, various clay minerals, and sand and gravel. In addition, small amounts of a wide variety of minerals were produced: Barite, bauxite, chromite, and marble for export and mag-

[1] Physical scientist, International Data and Analysis.

[2] Pakistan's fiscal year is from July 1 to June 30.

[3] Where necessary, values have been converted from Pakistani rupees (PRs) to U.S. dollars at the rate of PRs9.9=US$1.00.

nesite, ochers, soapstone, and sulfur for domestic consumption.

Processed mineral commodities were of significant importance to the country's economy. Production of cement, chemical fertilizers, and petroleum products reduced the need for expensive mineral imports. Pakistan planned to increase domestic production of all three products and to complete an integrated steelworks near Karāchi to further reduce imports of mineral commodities.

Table 1.—Pakistan: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum, bauxite, gross weight	274	--	165
Antimony ore:			
Gross weight	184	120	39
Metal content e	37	24	8
Chromium, chromite, gross weight	9,537	9,961	10,136
Iron and steel, mild steel products ---thousand tons--	212	231	231
Manganese ore, gross weight	7	93	58
NONMETALS			
Abrasives, natural, emery stone	387	710	992
Barite	5,157	4,598	9,380
Cement, hydraulic ---thousand tons--	3,503	3,120	3,096
Chalk	1,189	712	1,306
Clays:			
Bentonite	545	676	622
Fire clay	15,974	26,238	24,255
Fuller's earth	14,602	12,141	14,548
Kaolin (china clay)	1,109	366	572
Other	69,315	71,732	47,474
Feldspar	4,767	2,671	2,853
Fertilizer materials, manufactured:			
Nitrogenous:			
Gross weight	681,576	783,150	772,338
N content	289,845	333,326	326,324
Phosphatic, gross weight	21,171	42,330	60,410
Fluorspar	69	--	10
Gypsum, crude	273,183	569,245	442,998
Magnesite, crude	2,915	2,015	3,496
Pigments, natural mineral, ocher	15,236	1,713	15,940
Salt:			
Rock ---thousand tons--	386	409	375
Marine ---do----	134	131	144
Total ---do----	520	540	519
Sand and gravel:			
Gravel	89,971	54,150	49,989
Sand:			
Bajri and common	38,897	58,796	37,219
Glass	39,051	32,003	36,134
Sodium and potassium compounds:			
Caustic soda	39,548	38,241	30,660
Soda ash, manufactured	80,805	79,215	63,288
Stone:			
Aragonite and marble	23,597	33,219	28,224
Dolomite	639	483	349
Limestone ---thousand tons--	2,968	3,710	3,079
Crushed ---do----	2,446	172	925
Strontium minerals, celestite	379	1,033	686
Sulfur	2,128	1,227	1,563
Talc and related materials, soapstone	6,709	3,220	4,361
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades ---thousand tons--	r 1,100	1,000	1,300
Gas, natural, sales ---million cubic feet--	175,000	164,101	183,635
Natural gas liquids ---thousand 42-gallon barrels--	30	r e 25	e 32
Petroleum:			
Crude ---do----	2,923	2,190	2,562
Refinery products:			
Gasoline ---do----	2,177	2,090	2,152
Jet fuel ---do----	3,317	3,184	3,176
Kerosine ---do----	2,256	2,166	2,005
Distillate fuel oil ---do----	5,855	5,621	5,822
Residual fuel oil ---do----	8,813	8,460	9,032
Lubricants ---do----	611	587	501
Other ---do----	1,374	1,319	1,420
Refinery fuel and losses ---do----	951	913	834
Total ---do----	25,354	24,340	24,942

e Estimate. p Preliminary. r Revised.

TRADE

Pakistan's trade deficit continued to be substantial in 1975–76, increasing from about $330 million in fiscal 1973–74 to over $1.0 billion for the next two fiscal years. During fiscal 1975–76, exports increased almost 12%, but imports increased 10.7% over the same period. Pakistan has been able to finance a substantial portion of the deficit with foreign aid and remittances from Pakistani workers overseas.

Mineral trade constituted an important part of the trade deficit. Cement exports decreased from $29.6 million (revised) in fiscal 1974–75 to $7.82 million in fiscal 1975–76. Petroleum product and residual fuel oil exports were valued at $17.2 million, a slight increase over those of the previous fiscal year. Imports of crude oil and petroleum products increased from $337 million in fiscal 1974–75 to $377 million in fiscal 1975–76. Iron and steel and chemical fertilizers were the other major mineral imports. Pakistan planned to decrease the mineral trade deficit by increasing crude oil production, producing its own iron and steel, and expanding output of cement and chemical fertilizers.

The following tabulation lists the value of Pakistan's mineral imports, by major group:

Commodity or commodity group	Value of imports (millions)	
	1974–75	1975–76
Iron and steel, including ore and scrap	r $213.0	$171.6
Other metals, including ores and scrap	r 47.7	22.4
Fertilizer materials	r 104.0	11.8
Coal and coke	8.3	4.3
Crude and partly-refined petroleum	r 216.0	254.3
Petroleum refinery products	r 119.7	122.7
Other	r 18.4	11.6
Total	r 727.1	598.7

r Revised.

Table 2.—Pakistan: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974–75	1975–76
METALS		
Aluminum:		
Oxide and hydroxide	273	200
Metal including alloys:		
Scrap	1,740	7,154
Unwrought and semimanufactures	12,900	2,161
Arsenic trioxide, pentoxide, acid	5	43
Chromium oxide and hydroxide	3	3
Cobalt oxide and hydroxide	1	2
Copper:		
Ore and concentrate	45	64
Metal including alloys, unwrought and semimanufactures	7,161	2,266
Iron and steel:		
Ore and concentrate, including roasted pyrite	32	125
Metal:		
Scrap	134,024	138,334
Pig iron, sponge iron, powder, shot	119,581	28,332
Ferroalloys	7,712	3,502
Steel, primary forms	138,391	46,348
Semimanufactures	283,193	342,080
Lead:		
Ore and concentrate	78	347
Oxide	487	550
Metal including alloys, all forms	2,267	985
Manganese:		
Ore and concentrate	194	--
Oxide	836	1,000
Mercury 76-pound flasks	71,123	1,135
Nickel metal including alloys, all forms	139	106
Platinum-group and silver metals including alloys troy ounces	1,768	645
Tin metal including alloys, all forms	274	137
Titanium oxide	603	772

See footnote at end of table.

Table 2.—Pakistan: Imports of mineral commodities[1]—Continued

(Metric tons unless otherwise specified)

Commodity		1974–75	1975–76
METALS—Continued			
Zinc:			
Oxide		427	926
Metal including alloys:			
Scrap and blue powder		211	1,615
Unwrought and semimanufactures		4,917	1,994
Other:			
Ores and concentrates		60	--
Ash and residue containing nonferrous metals		165	69
Oxides, hydroxides, peroxides of metals, n.e.s		27	115
Metals including alloys, all forms:			
Metalloids		15	1
Alkali, alkaline earth, rare-earth metals		35	39
Base metals including alloys, all forms		123	1,150
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		561	423
Grinding and polishing wheels and stones		198	239
Asbestos, crude		4,374	5,647
Barite and witherite		1,185	201
Cement		107	123
Chalk		2,167	3,815
Clays and clay products:			
Crude:			
Bentonite		85	--
Fuller's earth		1,656	25
Kaolin		1,876	2,483
Other		1,347	1,093
Products:			
Refractory		5,985	7,414
Nonrefractory		521	32,028
Diatomite		66	--
Feldspar and fluorspar		22	35
Fertilizer materials:			
Crude:			
Nitrogenous		8,484	24
Phosphatic		23,782	34,444
Manufactured:			
Nitrogenous		300,707	43,320
Phosphatic		11,177	17,967
Mixed		20,673	6,442
Ammonia		11	8
Graphite, natural		112	552
Magnesite		598	829
Pigments, mineral, including processed iron oxides		298	883
Precious and semiprecious stones, except diamond	kilograms	3,017	1,460
Sodium and potassium compounds:			
Caustic soda		2,734	34,013
Caustic potash		254	31
Sodic and potassic peroxides		4	105
Stone, sand and gravel:			
Dimension stone, crude and partly worked		83	21
Gravel and crushed rock		--	7
Quartz and quartzite		55	--
Sand, excluding metal bearing		1	21
Sulfur:			
Elemental, all forms		20,752	7,077
Sulfuric acid		37	16
Talc, steatite, soapstone, pyrophyllite		186	20
Other:			
Crude		901	2,025
Bromine, iodine, fluorine		3	1
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		27	133
Carbon black		1,962	1,292
Coal and coke, including briquets		77,661	39,625
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	18,827	20,710
Refinery products:			
Gasoline	do	300	406
Jet fuel	do	13	2
Kerosine	do	2,974	2,350
Distillate fuel oil	do	5,519	5,899
Residual fuel oil	do	62	28
Lubricants	do	57	22
Other:			
Paraffin, petroleum jelly, wax	do	27	75
Unspecified	do	53	1,198
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		3,533	844

[1] Data are for fiscal years beginning July 1.

COMMODITY REVIEW

METALS

Bauxite.—A minor amount of bauxite was produced from small operations in the Salt Range of Punjab Province in 1976. Exploration by PMDC has proven 180 million tons of low-grade bauxite near Khushāb, Punjab, south of the Salt Range.

Chromite.—Production of chromite, the only metallic mineral that Pakistan produced for export, was about 10,136 tons in 1976. Production remained well below the average annual level of 25,000 tons during the 1960's owing to the high iron content of the ore, the generally low level of mechanization, and high transport costs. The bulk of the 1976 output came from the chromite deposits in the Muslimbagh area of Baluchistan. The Government planned to build a 15,000-ton-per-year ferrochrome plant near Muslimbagh with aid from West Germany.

Copper.—RDC completed evaluation of the Saindak copper deposit near the Pakistani-Iranian border in Chāgai District, Baluchistan. At a minimum grade of 0.3% copper, the northern, southern, and eastern ore bodies had proven reserves of 19 million, 54 million, and 264 million tons, respectively. The average grade was 0.5%, 0.5%, and 0.4%, respectively. In addition, the northern ore body contained 9 million tons averaging 0.51 gram of gold per ton and the southern ore body contained 54 million tons averaging 0.49 gram of gold per ton. The southern ore body also had 29 million tons of ore averaging 0.019% molybdenum, and the eastern ore body had 55 million tons of ore averaging 0.017% molybdenum. Seltrust Engineering Ltd. of the United Kingdom was appointed to complete a preinvestment feasibility study of the Saindak deposit by the end of 1977. One of the major obstacles to the development of this remote deposit was overcome when sufficient fresh water was found less than 80 kilometers from the area. Exploration drilling was conducted during 1976 on a copper prospect at Talarukh, Baluchistan, about 56 kilometers northeast of Saindak.

Iron and Steel.—The Government-owned Pakistan Steel Mill Corp. (PASMIC) continued erecting a 1.1-million-ton-per-year steelmill at Pipri, east of Karāchi, during 1976. Extensive technical and financial assistance for the project was provided by the U.S.S.R. The steelmill was to be in full operation by 1980 with initial production to commence in 1978. A new bulk cargo port was also being built at Qāsim to handle iron ore and coal imports for the steelmill. Domestic deposits were to supply the steelmill with limestone (400,000 tons per year), dolomite (270,000 tons per year), fire clay (44,000 tons per year), and fluorite (4,000 tons per year).

Pakistan has investigated domestic deposits containing over 400 million tons of iron ore, but the generally low iron content and limited accessibility of the deposits have deterred their development.

The remote Chitrāl deposits in western North-West Frontier Province, containing over 3 million tons of magnetite ore averaging over 50% iron, were to be studied in detail. A 100,000-ton iron and steel plant was to be built at Chilghaz in the Chāgai District of Baluchistan with aid from the People's Republic of China. The 2.4-million-ton, 43% to 53% iron ore deposit near Chilghaz was to be exploited to feed the new plant.

NONMETALS

Barite.—A 30,000-ton-per-year barite grinding plant came onstream in mid-1976 at Khuzdār in the mountainous region of east-central Baluchistan. The 1976 output of the plant came from the 1.2-million-ton Shekrān barite deposit. Barite production from the small-scale mines in North-West Frontier Province was about 4,000 tons during 1976. The bulk of barite produced was exported to the oil-producing countries of the Middle East.

Cement.—Output from Pakistan's nine cement plants decreased 4% during fiscal 1975–76. Cement exports during the same period fell drastically (73%). The Government had planned to increase the country's cement capacity by 3.5 million tons per year, but economic difficulties delayed the project.

Fertilizer Materials.—Phosphate rock deposits located in difficult mountainous terrain near Abbotābād in the Hazāra District of North-West Frontier Province were

under investigation during 1976. Reserves of about 4 million tons have been identified. Pakistan National Fertilizer Corp. planned to set up a phosphate fertilizer plant at Haripur to utilize these deposits. The plant was to produce urea, phosphoric acid, superphosphate, and diammonium phosphate.

Construction of the $100 million expansion to the Multān fertilizer plant was underway in 1976. The new unit, a joint venture of Pakistan and Abu Dhabi National Oil Company, was to be onstream in late 1977 and produce nitric acid, ammonium nitrate, and calcium nitrate. Domestic natural gas was to be used as feedstock for the plant.

A 1,000-ton-per-day ammonia, 1,750-ton-per-day urea plant was to be built with Saudi Arabia's assistance at Mīrpur Māthelo near Sukpur. The $200 million project was to begin operations in early 1977.

Salt.—Pakistan has large reserves of rock salt in the Salt Range of Punjab Province. Rock salt production has remained stable at about 400,000 tons for several years. PMDC planned to upgrade the Khewra, Worcha, and Kālābagh mines to increase annual production by about 250,000 tons. Solar-evaporated sea salt was produced by 20 small operations along the coast and output was estimated at 144,000 tons during 1976.

Stone.—*Limestone.*—Extensive deposits of limestone occur in all four provinces of Pakistan. Limestone was mined for use by the cement industry and as building and construction material. With the establishment of an integrated steel complex at Karāchi and the projected increase in cement output, limestone production was expected to increase from 3.1 million tons in 1976 to about 7 million tons per year in 1980.

MINERAL FUELS

Coal.—The coal deposits of Pakistan were low grade with generally poor coking properties. Total recoverable reserves were estimated at 400 million tons including 250 million tons in the Lakhra coalfields of Sind Province. Production of coal has remained fairly stable at 1.2 million to 1.5 million tons for nearly a decade. During 1976, coal output was estimated at 1.3 million tons, but as a large but unknown percentage of coal was used locally to fire brick kilns, an accurate figure was unattainable. The coal industry continued to have difficulties because the larger producers used old mining equipment, had very few trained personnel, and operated in rough terrain.

The Sharigh coalfields, near Quetta, Baluchistan, were the only fields that contained some coal of medium-coking quality. The Government planned to expand the existing mines and build a mechanical washing plant at Sharigh. The washed coal would augment the imported coking coal at the Karāchi steelmill.

The Government planned to develop coal mines in the Lakhra Field and use the output to power a 250-megawatt thermal power station to be built at Jām Shoro, Sind.

Natural Gas.—Natural gas was the only abundant mineral fuel in Pakistan in 1976. Output from the Sui and Mari gasfields was approximately 4.98 billion cubic meters, with the bulk of the production from the Sui Field. Gas reserves at the Sui and Mari Fields were estimated at 223 billion and 117 billion cubic meters, respectively, and in dormant gasfields and associated with petroleum, 65 billion cubic meters. Efforts continued to extend the service area of the country's natural gas companies to increase availability of natural gas to consumers in northern Pakistan.

During 1976, the Government and Esso Eastern Inc. signed an agreement in which the State acquired Esso's petroleum refining and retail interests. Esso agreed to invest the proceeds into developing the Mari gasfield. The increased output from Mari was to be used as feedstock for urea fertilizer plants.

Petroleum.—Domestic crude oil production from the Potwar Plateau fields increased from 300,000 tons in 1975 to 351,000 tons in 1976, but was well below the 400,000-ton output of 1974. Domestic production satisfied about 12% of domestic demand during the year. In December, the Prime Minister announced an important oil/gas discovery by OGDC at Dhodak, west of the Indus River in southern Punjab. It was the first liquid hydrocarbon discovery in Pakistan outside of the Potwar fields. Initial estimates of the find were placed at 200 million barrels of light oil and 4.5 trillion cubic feet of

sulfur-free natural gas. The payout zone was between 7,000 and 8,000 feet in the Cretaceous, and initial tests showed a potential flow of 2,000 barrels of crude per day and 19.5 million cubic feet of natural gas per day. Crude oil reserves in Pakistan had been estimated at 75 million barrels prior to the Dhodak discovery. Development of the field was to take 2 to 3 years, and, together with the planned development of older fields, Pakistan would produce 70,000 to 80,000 barrels of oil per day, sufficient to meet domestic demand.

On November 2, 1976, Ordinance No. XLIV of 1976 was published in an effort to stimulate oil exploration by foreign firms. The ordinance offered a new package of tax concessions to foreign oil companies. Exploration and drilling equipment imported by foreign petroleum companies prior to an oil discovery would not be subject to import or sales taxes. In addition, taxes imposed on foreign employees of the companies were to be significantly reduced.

The 12,500-barrel-per-day addition to the national refinery near Karāchi was nearing completion at yearend. New visbreaking and distillate hydro-desulfurization units were also being added with completion expected in 1977. The 40,000-barrel-per-day Pak-Arab refinery, a joint Pakistani-Abu Dhabi venture, was to be built at Multān in south-central Punjab. The refinery would be supplied with imported crude oil shipped by pipeline from Karāchi to the refinery site, a distance of about 750 kilometers. The Government also planned to supply the refinery with crude oil from the new Dhodak oilfield 160 kilometers from the Multān site.

The Mineral Industry of Peru

By Orlando Martino [1]

The reduced rate of economic growth experienced in 1975 continued into 1976. The real growth rate of the gross domestic product (GDP) was 3% for the year, compared with an average of almost 6% for 1972–74. There was a sharp increase in the rate of inflation to 45% in 1976 from 24% in 1975 and a 10.6% average annual increase for the decade ending in 1974.

Peru's mineral industry had a better than average performance in 1976, accounting for 7% of the estimated GDP of $13.7 billion [2] at current prices. The value of mineral exports increased 24% to $697 million and made up 51% of Peru's total export earnings. Peru's export-oriented mineral industry was again dominated by copper, zinc, silver, iron ore, and lead.

Two outstanding new developments in the minerals and mineral fuels area marked the year: Completion of the large-scale copper mining project at Cuajone and of the 853-kilometer trans-Andean crude oil pipeline. The former resulted in an 80% increase (156,000 tons per year) in Peru's copper capacity. The latter, designed to transport crude oil from jungle areas, offers the probability that Peru will become self-sufficient in crude oil in late 1978.

The mineral industry of Peru, excluding mineral fuels, is composed of the large-scale, medium-scale, and small-scale mining sectors. The large-scale group includes Empresa Minera del Perú (Minero Peru), involved in diversified mining outside central Peru; Empresa Minera del Centro del Perú (Centromin), involved in diversified mining in central Peru; Empresa Minera de Hierro del Perú (Hierro Peru), involved in mining of iron ore only; and Southern Peru Copper Corporation (SPCC). The four firms, three Government-owned and the last privately owned, accounted for 65% of Peru's mineral output (excluding mineral fuels).

At yearend, Minero Peru, created in 1970, was approaching completion of its first mining operation, the Cerro Verde copper complex, to produce 33,000 tons of fine copper per year. In November, it signed a contract with a Belgian firm for construction of the new zinc refinery at Cajamarquilla.

Centromin continued as Peru's second largest copper producer (after SPCC), deriving 22% of its total revenues from this commodity in cathode, blister, and wirebar forms. Copper was mined at Cobriza (the major producing mine), Yauricocha, Cerro de Pasco, Morococha, Casapalca, and San Cristóbal.

About 55% of the ore treated by Centromin came from mines not belonging to it. The major event of 1976 was the startup of the expanded copper refinery at La Oroya, which resulted in a 25% increase in Centromin's output of refined copper to 45,786 tons. In November 1976, Centromin entered into loan agreements with the World Bank and the Inter-American Development Bank for $73.4 million to finance expansion of the mine and concentrator at Cobriza from 2,000 tons to 10,000 tons per day and conversion of the mine-water treatment plant at Cerro de Pasco from scrap iron precipitation to a solvent extraction and electrowinning process.

The medium-scale mining sector was composed of 60 privately owned companies

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[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Peruvian soles (S/) to U.S. dollars at the annual average rate of S/55.8=US$1.00. At yearend, the rate was S/69.1=US$1.00.

primarily involved in the production of copper, lead, zinc, and silver ores. This sector employed about 26,000 workers and accounted for 30% of Peru's mineral output. The leading medium-scale producers of copper, lead, zinc, and silver were, respectively, Minas de Cobre de Chapi S.A., Cia. Minera Atacocha S.A., Cia. Minera San Ignacio de Morococha, S.A., and Cia. de Minas Buenaventura, S.A.

The small-scale mining sector comprised more than 1,000 privately owned small mines, although only 200 were officially registered. The majority of these operations were poorly mechanized and labor intensive. This sector accounted for only 5% of Peru's mineral output. The Small Private Enterprise Sector was recognized as a separate group by Decree Law 21435 of February 1976.

A large portion of the concentrates produced by the medium- and small-scale sectors were sold to Centromin for smelting and refining.

In 1976, the Banco Minero del Perú substantially increased its financial assistance to the medium and small miners by extending credits of $76.4 million. Under its metallurgical program, the Banco Minero planned to invest $450,000 in the construction and expansion of beneficiation plants in different parts of Peru to service small miners.

In the mineral fuels area, Government-owned Petróleos del Perú (Petroperu), Belco Petroleum Corp. del Perú, and Occidental Petroleum Corp. del Perú were the main crude oil producers.

During 1976, 77,000 were employed in mining and 12,000 in petroleum operations. Of the mining total, Centromin employed 15,900 and SPCC 5,500.

Government Policies and Programs.—At midyear, the Government initiated an austerity program to curb inflation and reduce the deficit in the balance of payments. The Peruvian sol was devaluated 45%, and a 15% tax was imposed on exports. The last sizable devaluation occurred in September 1967.

It was an active year for mining legislation. A number of laws and regulations were issued to financially assist the small-scale and medium-scale mining sectors through the Banco Minero. In addition, the Government released over 13.5 million hectares of mineral-rich areas previously reserved for the State in the Departments of Pasco, Junín, Ayacucho, Apurímac, and Cuzco for prospecting by private mine operators. Peru's mineral potential is largely undeveloped; only 1.6% of 86 million hectares with mining possibilities was in production at yearend.

Decree Law 21462 of April 1976 declared mining to be in a state of emergency and authorized mining companies to rescind labor contracts of workers engaged in illegal work stoppages. This action was reinforced in July when the Government declared a state of national emergency, making all strikes illegal.

PRODUCTION

Mineral production rebounded from the decline of 1975. The general increase was attributed primarily to the absence of labor strikes which had been declared illegal by the Government during the year. Mine output of copper increased 21%, rebounding from the depressed level of 1975, while output of refined copper increased 96%. Mine output of lead increased 4%, zinc 15%, and silver 5%. There was a sharp 38% decline in iron ore production as Hierro Peru sought to adjust its output to world market demand. Raw steel production declined 19%.

Centromin operated six mines and continued as a major producer of refined metals and subproducts at its complex metallurgical plant in La Oroya, west of Lima, as detailed in table 1.

Centromin also produced lead, zinc, and tungsten concentrates for export, which accounted for 21% of its sales revenues in 1976. The metallic content of tungsten concentrates declined 14% from 521 tons to 449 tons in 1976.

An annual record high of 201,514 tons was set by Centromin in the recovery of zinc, chiefly at its Cerro de Pasco mine. Centromin's major copper producer, Cobriza, increased its output 8.4%.

Crude oil production increased 6% in 1976. Production increases on the continen-

tal shelf and in the jungle areas more than compensated for the declining trend in the north-central area. Oil output from the jungle areas increased 43%. Production of natural gas from the coast decreased 6%, and production from the continental shelf increased 23%. Nationwide natural gas production remained about the same.

Data on total mineral production for 1974–76 are shown in table 2.

Table 1.—Peru: Centromin's production of metals and subproducts

(Fine metric tons unless otherwise specified)

Commodity	1975	1976	Percent change
Refined metals:			
Copper bars, wire, cathodes	36,587	45,786	+25
Lead	70,966	74,066	+4
Zinc	61,975	64,382	+4
Silver, troy ounces	17,861,266	19,227,701	+8
Gold, do.	31,046	34,679	+12
Bismuth	500	456	−9
Cadmium	160	174	+9
Indium, kilograms	1,447	2,982	+106
Selenium, do.	6,689	8,752	+31
Tellurium, do.	21,208	12,332	−42
Metals in blister copper for export:			
Copper content	12,764	5,525	−57
Silver content, troy ounces	2,629,652	1,256,345	−52
Gold content, do.	6,497	2,753	−58
Subproducts and alloys:			
Zamac alloys	1,267	161	−87
Antimony, crude	171	335	+96
Antimonial lead	253	44	−83
Arsenic, white	1,283	797	−38
Copper sulfate	4,736	4,422	−7
Zinc sulfate	1,785	1,823	+2
Zinc powder	398	372	−7
Sulfuric acid	48,581	47,756	−2

Source: Centromin Annual Report 1976, p. 8.

Table 2.—Peru: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Antimony:			
Mine output, metal content	317	122	603
Metal	266	107	339
Arsenic, white	1,973	1,260	797
Bismuth:			
Mine output, metal content	665	505	521
Metal	615	500	456
Cadmium:			
Mine output, metal content	487	503	360
Metal	182	160	174
Copper:			
Mine output, metal content	211,593	165,813	200,788
Copper sulfate	4,640	1,104	4,422
Metal:			
Smelter	r 176,502	156,610	184,549
Refined	38,955	71,476	140,116
Gold:			
Mine output, metal content, troy ounces	100,400	100,799	80,730
Metal, do.	r 76,314	71,476	74,204
Indium, kilograms	2,369	1,587	3,270
Iron and steel:			
Iron ore and concentrate, thousand tons	9,525	7,753	4,776
Pig iron, do.	303	286	232
Ferroalloys	1,008	895	320
Steel, ingots and castings, thousand tons	450	432	349
Lead:			
Mine output, metal content	165,798	184,490	159,758
Metal	r 80,557	71,142	74,121
Manganese:			
Ore and concentrate, gross weight	1,634	2,045	613
Metal content	r 613	740	164

See footnotes at end of table.

Table 2.—Peru: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS—Continued			
Mercury ---------- 76-pound flasks	3,252	1,530	--
Molybdenum, mine output, metal content	650	443	453
Selenium, refined ---------- kilograms	7,747	6,681	8,754
Silver:			
Mine output, metal content ---------- thousand troy ounces	34,881	34,027	35,579
Metal ---------- do	17,914	18,529	19,452
Tellurium metal ---------- kilograms	36,474	21,166	12,306
Tin, mine output, metal content	155	255	273
Tungsten, mine output, metal content	703	625	591
Zinc:			
Mine output, metal content	378,029	364,915	421,310
Metal, refined	68,957	63,241	64,680
NONMETALS			
Barite	357,797	331,700	330,689
Cement, hydraulic ---------- thousand tons	r 1,902	1,950	1,966
Chalk	385,664	361,615	NA
Clays:			
Bentonite	12,916	39,545	e 40,000
Fire	5,459	10,743	19,085
Kaolin	4,077	9,516	9,116
Common	131,623	371,443	328,811
Diatomite	2,410	17,239	e 18,000
Feldspar	4,088	3,905	e 4,000
Graphite	--	59	59
Gypsum, crude	348,548	210,543	171,726
Mica	4	2	e 10
Phosphate, guano e	23,000	20,000	20,000
Salt, all types	338,215	304,216	304,216
Stone:			
Dimension, marble [1]	11,958	3,204	NA
Crushed and broken:			
Dolomite	5,239	23,662	24,500
Sand and gravel ---------- thousand tons	2,612	4,439	4,052
Limestone ---------- do	3,224	3,166	3,144
Quartz and quartzite	3,373	3,681	6,955
Silica sand ---------- thousand tons	20	261	300
Slate	--	665	NA
Sulfur:			
Elemental	137	593	e 600
Sulfuric acid and oleum	49,630	48,580	NA
Talc, pyrophyllite, related materials	13,781	13,864	13,562
MINERAL FUELS AND RELATED MATERIALS			
Coal:			
Anthracite	150	22,929	10,816
Bituminous	180	--	e 200
Coke, all types e	12,000	12,000	10,000
Gas, natural:			
Gross ---------- million cubic feet	69,848	64,959	71,597
Marketed ---------- do	r 31,809	29,398	e 32,500
Natural gas liquids:			
Natural gasoline [2] ---------- thousand 42-gallon barrels	r 453	510	508
Propane ---------- do	r 210	125	79
Butane ---------- do	r 5	5	7
Total ---------- do	r 668	640	594
Petroleum:			
Crude ---------- do	28,069	26,294	27,936
Refinery products:			
Gasoline:			
Aviation ---------- do	3	1	1
Motor ---------- do	11,812	12,995	12,336
Jet fuel ---------- do	1,915	1,844	1,628
Kerosine ---------- do	4,596	4,696	4,990
Distillate fuel oil ---------- do	7,325	7,271	7,710
Residual fuel oil ---------- do	12,763	12,786	13,194
Lubricants ---------- do	86	87	108
Other:			
Liquefied petroleum gas ---------- do	534	1,202	1,091
Asphalt ---------- do	216	230	296
Unspecified ---------- do	116	208	150
Refinery fuel and losses ---------- do	370	317	488
Total ---------- do	39,736	41,637	41,992

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Includes crushed marble.

[2] Includes hexane.

TRADE

The value of Peru's mineral exports increased 24% to $697 million from $560 million in 1975. Mineral exports represented 51% of total export earnings, compared with 45% in 1975. Preliminary export data for 1976 developed by the Peruvian Mining and Petroleum Society for the leading mineral commodities are shown in the following tabulation:

Commodity	Quantity	Value, f.o.b.		
		Million dollars	Percent of total	Percent increase over 1975
Copper ----------metric tons--	188,900	211.0	30	31
Iron ore ----------do----	3,250,000	66.1	10	27
Lead ----------do----	174,300	51.6	7	26
Silver ----------thousand troy ounces--	40,027	148.7	21	6
Zinc ----------metric tons--	442,100	164.9	24	11
Other ----------do----	NA	55.0	8	224
Total ----------	XX	697.3	100	24

NA Not available. XX Not applicable.

During a visit to Peru in November by the President of Brazil, an agreement was signed under which 35% of Brazilian imports of copper and zinc would come from Peru.

Although Peru exported a variety of minerals, exports of copper, iron ore, lead, silver, and zinc contributed 92% of total mineral export value. Marketing of the minerals overseas was centralized in the Government-owned company Minero Perú Comercial (Minpeco). To resume shipments of iron ore to Japan, Minpeco signed export contracts with Kobe Steel, Ltd., and Nippon Steel Corporation during 1976.

Exports of crude oil in 1976, mostly to Brazil and Argentina, increased 35% to 2.0 million barrels, while exports of petroleum products, mostly residual fuel oil, increased 99% to 1.4 million barrels. It was the second year of exports of crude petroleum from jungle oilfields; these exports increased 103% from 983,000 barrels in 1975 to 1,992,000 barrels in 1976. The major part of the exports went to Brazil by way of the Amazon River.

Imports of crude oil from Ecuador, Venezuela, and Colombia totaled 16.9 million barrels, a slight increase over those of 1975, while the cost of the oil imports increased 96%. Of the crude oil processed at Peru's refineries, 40% was imported. Peru spent $270 million to import crude oil and petroleum products in 1976. Less than 1% was imported from the United States.

Table 3.—Peru: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal, semimanufactures -----	r 105	148	Bolivia 114; Ecuador 34.
Antimony:			
Ore and concentrate ----------	530	817	Belgium-Luxembourg 444; West Germany 189; India 104.
Metal including alloys, all forms -----	--	21	All to United States.
Arsenic trioxide, pentoxide, acids --------	288	250	Argentina 113; United States 63; Netherlands 52.
Bismuth metal including alloys, all forms-	620	220	U.S.S.R. 77; Belgium-Luxembourg 70; United States 42.
Cadmium metal including alloys, all forms-	253	150	United States 118; Belgium-Luxembourg 15.
Copper:			
Ore and concentrate ----------	77,596	103,362	North Korea 24,928; Japan 23,819; United States 16,229; Romania 10,319.
Matte ----------	1,230	384	Spain 226; Netherlands 158.
Copper sulfate ----------	368	86	Colombia 61; United Kingdom 20.

See footnotes at end of table.

Table 3.—Peru: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Copper—Continued			
Metal including alloys:			
Unwrought:			
Blister	r 163,750	122,160	United States 34,331; People's Republic of China 33,080; West Germany 15,416.
Refined	r 119	36	Venezuela 30; Ecuador 6.
Semimanufactures	r 7,718	4,791	Colombia 1,689; El Salvador 800; Ecuador 684; Venezuela 560; Uruguay 533.
Gold metal, content of mixed bars troy ounces	20,062	--	
Iron and steel:			
Ore and concentrate (except roasted pyrite) thousand tons	10,487	5,332	Japan 2,472; United States 1,550.
Metal:			
Pig iron, including cast iron	13	--	
Semimanufactures	3,698	1,625	Bolivia 601; Chile 424; Brazil 279; Ecuador 222.
Lead:			
Ore and concentrate	153,481	118,079	United States 45,250; Japan 45,039.
Oxides	1,014	621	Colombia 211; Venezuela 166; Argentina 111; Panama 101.
Metal:			
Scrap	--	65	All to Ecuador.
Unwrought	r 83,657	63,994	People's Republic of China 20,493; Italy 13,066; United States 11,057.
Semimanufactures	26	28	All to Ecuador.
Mercury 76-pound flasks	2,711	1,011	Mainly to United States.
Molybdenum ore and concentrate	1,366	1,014	United States 341; Sweden 213; Netherlands 175; Belgium-Luxembourg 138.
Selenium, elemental	7	3	Argentina 1; United States 1.
Silver:			
Ore and concentrate	--	1,121	All to Sweden.
Metal including alloys thousand troy ounces	18,697	18,196	United States 9,020; Japan 7,155.
Tellurium, elemental	28	29	Mainly to United States.
Tin:			
Ore and concentrate	598	703	All to United Kingdom.
Metal including alloys, all forms	132	11	All to Ecuador.
Tungsten ore and concentrate	1,051	1,483	United States 818; Japan 331; West Germany 256.
Zinc:			
Ore and concentrate	670,707	647,621	Japan 246,930; France 64,157.
Oxide	529	300	Venezuela 149; Ecuador 84; Colombia 58.
Metal including alloys, all forms	62,178	64,141	Brazil 21,793; United States 14,488; Netherlands 7,435.
Other:			
Ash and residue containing nonferrous metals	50,393	10,544	Belgium-Luxembourg 10,420.
Metals including alloys, all forms	2	(1)	All to United States.
Oxides, hydroxides, peroxides of metals, n.e.s	--	2	All to West Germany.
NONMETALS			
Barite and witherite	357,977	357,477	United States 212,428; Netherlands 97,565.
Boron, crude natural borates	64	589	Mexico 203; Colombia 200; Brazil 176.
Cement, hydraulic	19,893	1,255	All to Ecuador.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	147	836	Colombia 744; Ecuador 92.
Kaolin	--	52	All to Bolivia.
Products	502	74	Bolivia 52; Panama 13; Ecuador 8.
Fertilizer materials:			
Crude	r 1	--	
Manufactured	46	25	Ecuador 15; Bolivia 10.
Lime	--	350	All to Ecuador.

See footnotes at end of table.

Table 3.—Peru: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Precious and semiprecious stones	--	1	Mainly to United States.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	228	278	Colombia 215; Venezuela 63.
Worked	3	--	
Quartz and quartzite	--	(1)	All to West Germany.
Sulfuric acid	87	65	Bolivia 40; Ecuador 25.
Talc	1	3	All to Ecuador.
MINERAL FUELS AND RELATED MATERIALS			
Coal and briquets	95	10	All to Bolivia.
Petroleum:			
Crude ----thousand 42-gallon barrels	--	1,482	Brazil 1,134; Argentina 211; Venezuela 137.
Refinery products:			
Gasoline ----------do----	--	6	All to Ecuador.
Distillate fuel oil ----------do----	202	--	
Residual fuel oil ----------do----	2,477	502	NA.
Lubricants ----------do----	(1)	99	NA.
Other:			
Liquefied petroleum gas ----------do----	2	96	All to Ecuador.
Unspecified ----------do----	5	1	All to Ecuador and Bolivia.
Total ----------do----	2,686	704	

r Revised. NA Not available.
1 Less than ½ unit.

Table 4.—Peru: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	4,499	2,373	Mainly from United States.
Oxide and hydroxide	r 2,142	3,838	West Germany 2,437; United States 1,082.
Metal including alloys, all forms:			
Scrap	--	4	All from United States.
Unwrought	6,847	7,095	Venezuela 4,887; Canada 1,635.
Semimanufactures	2,519	2,879	France 741; West Germany 609; United States 330.
Antimony metal including alloys, all forms	38	2	Mainly from Japan.
Arsenic:			
Natural sulfides	--	(1)	All from United States.
Trioxide, pentoxide, acids	(1)	5	Do.
Chromium:			
Ore and concentrate	3,991	3,078	Philippines 2,000; United States 1,021.
Oxide and hydroxide	r 35	51	West Germany 36; United States 7.
Metal including alloys, all forms kilograms	1,503	4,930	United States 2,004; Canada 1,042; France 626.
Cobalt oxide and hydroxide	(1)	1	Mainly from West Germany and United States.
Copper:			
Ore and concentrate	572	645	All from Bolivia.
Copper sulfate	205	1	Mainly from West Germany and Italy.
Metal including alloys:			
Unwrought	22	14	Denmark 10; France 2; Norway 1.
Semimanufactures	2,080	1,072	Chile 379; Japan 286; West Germany 190; Mexico 143.
Gold metal, unworked or partly worked troy ounces	r 5,391	97	All from United States.

See footnotes at end of table.

Table 4.—Peru: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Iron and steel:			
Ore and concentrate	39	29	All from United States.
Metal:			
Scrap	(2)	62,950	Do.
Pig iron, ferroalloys, similar materials	r 4,952	11,703	Republic of South Africa 8,904; Pakistan 1,354.
Steel, primary forms	r 14,786	9,679	Mainly from United States.
Semimanufactures:			
Bars, rods, angles, shapes, sections	r 68,749	45,131	Japan 20,885; Poland 5,488; West Germany 4,981; United States 4,494.
Universals, plates, sheets	r 126,480	95,358	Japan 33,557; Canada 19,319; United States 18,331; France 14,876.
Hoop and strip	r 4,404	3,922	Japan 1,954; United States 932; West Germany 731.
Rails and accessories	r 2,291	10,239	United States 2,633; France 2,625; Belgium-Luxembourg 2,258; United Kingdom 1,254.
Wire (excluding wire rod)	r 5,610	5,524	Japan 3,038; West Germany 1,198; Belgium-Luxembourg 503.
Tubes, pipes, fittings	r 34,987	104,855	United States 34,544; West Germany 30,011; Japan 27,638.
Castings and forgings, rough	r 4,379	9,835	United States 5,571; Italy 1,846; Australia 1,206.
Lead:			
Oxides	(1)	1	Mainly from Italy.
Metal including alloys, all forms	25	12	United Kingdom 8; United States 3; Japan 1.
Magnesium metal including alloys, all forms	11	8	West Germany 3; Argentina 2; United States 2; Switzerland 1.
Manganese:			
Ore and concentrate	--	4	Mainly from United States and United Kingdom.
Oxide	r 1,814	2,170	United States 977; Japan 560; Mexico 291; Belgium-Luxembourg 211.
Mercury ----------76-pound flasks	6	3	West Germany 2; Italy 1.
Nickel:			
Matte, speiss, similar materials	1	1	All from Spain.
Metal including alloys, all forms	76	129	United States 57; West Germany 47.
Platinum-group and silver metals including alloys:			
Platinum-group ----------troy ounces	r 1,303	1,443	U.S.S.R. 1,279; United States 161.
Silver ----------do	--	1,125	United States 547; United Kingdom 322; West Germany 256.
Rare-earth metals:			
Oxides	2	11	France 6; West Germany 3; United Kingdom 2.
Metals including alloys ---kilograms	--	328	Italy 182; West Germany 92; Japan 54.
Tin:			
Oxides	7	(1)	Mainly from Italy and West Germany.
Metal including alloys, all forms	217	276	Mainly from Bolivia.
Titanium oxide	r 1,979	2,406	Finland 940; West Germany 571; Belgium-Luxembourg 406; United States 243.
Tungsten metal including alloys, all forms	4	3	United States 2; Switzerland 1.
Zinc:			
Oxides	7	13	West Germany 12; United States 1.
Metal including alloys, all forms	134	87	United States 71.
Other:			
Ores and concentrates	r 312	115	All from Australia.
Oxides, hydroxides, peroxides of metals	r 135	145	Norway 60; Japan 31; West Germany 23; United States 22.
Metals including alloys, all forms	7	11	Belgium-Luxembourg 7; United Kingdom 2; Republic of South Africa 1.

See footnotes at end of table.

Table 4.—Peru: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	r 114	106	United States 55; West Germany 21; Netherlands 21.
Grinding and polishing wheels and stones	r 264	122	West Germany 27; United States 20; Colombia 13.
Asbestos	7,839	17,238	Canada 8,765; U.S.S.R. 3,068; Australia 2,351; West Germany 2,001.
Barite and witherite	29	286	Brazil 171; West Germany 109.
Boron materials:			
Crude natural borates	--	1	All from United States.
Oxide and acid	175	151	United States 128; West Germany 16.
Cement	5,072	4,429	Mainly from United States.
Chalk	646	226	France 116; United States 110.
Clays and clay products (including all refractory brick):			
Crude:			
Bentonite	1,965	3,006	Mainly from United States.
Kaolin	r 2,228	4,107	United States 3,172; United Kingdom 795.
Other	2,793	2,357	United Kingdom 1,233; Japan 363 West Germany 327; United States 285.
Products	3,951	9,682	United States 3,775; West Germany 1,767; United Kingdom 1,631; Brazil 1,139.
Cryolite and chiolite	20	2	All from Denmark.
Diamond, all grades ____value, thousands__	r $841	$1,126	United States $452; Venezuela $407; Belgium-Luxembourg $267.
Diatomite	1,471	2,091	Mexico 1,940.
Feldspar and fluorspar	3,126	1,460	Canada 864; Republic of South Africa 310.
Fertilizer materials:			
Crude, phosphatic	13,908	5,882	All from United States.
Manufactured:			
Nitrogenous	r 128,239	102,520	United States 33,988; Netherlands 33,708; West Germany 16,417.
Phosphatic	50	26,221	All from United States.
Potassic	6,759	11	United States 10; West Germany 1.
Mixed	r 224	30,869	France 13,490; Netherlands 12,913.
Ammonia	11	--	
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	r 763	963	All from Italy.
Worked	54	62	Mainly from Italy.
Dolomite	730	2,603	Spain 1,982; Italy 620.
Gravel and crushed rock	52	--	
Quartz and quartzite	14	61	United States 33; West Germany 10; Mexico 8; Belgium-Luxembourg 6.
Sand, excluding metal bearing	r 4,630	2,255	Mainly from United States.
Sulfur:			
Elemental:			
Other than colloidal	10,256	3,793	Mainly from Venezuela.
Colloidal	2	256	Mainly from United States.
Sulfur dioxide	2	45	Do.
Sulfuric acid	1	1	Mainly from United Kingdom.
Other:			
Slag, dross, and similar waste, not metal bearing	10	30	All from United States.
Oxides and hydroxides of strontium, barium, magnesium	246	636	Mainly from United States.
Bromine, iodine, fluorine	3	4	France 1; West Germany 1; United Kingdom 1.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	r 114	175	United States 120; Japan 55.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	139	70	United States 58; United Kingdom 12.
Carbon black and gas carbon	4,219	3,565	Mainly from Colombia.

See footnotes at end of table.

Table 4.—Peru: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Coal and briquets:			
Anthracite and bituminous coal	44,764	46,851	Mainly from United States.
Lignite and lignite briquets	143	258	Do.
Coke and semicoke	113,258	233,052	Mainly from Japan.
Gas, hydrocarbon	17,048	14,171	Mainly from Venezuela.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r 10,188	16,586	Ecuador 9,864; Venezuela 6,567.
Refinery products:			
Gasoline:			
Aviation do	r 64	436	Venezuela 158; Chile 151; Netherlands 87.
Motor do	r 166	87	Brazil 68; Netherlands 12.
Kerosine do	r 23	158	Bahamas 128; Brazil 30.
Jet fuel do	r 103	373	Spain 167; Netherlands 128; Brazil 69.
Distillate fuel oil do	r 438	1,139	Netherlands 398; Venezuela 353; Bahamas 204; Brazil 158.
Residual fuel oil do	r 1,891	759	Venezuela 706.
Lubricants do	r 285	468	Venezuela 209; Netherlands Antilles 173; United States 76.
Mineral jelly and wax do	79	151	Japan 71; West Germany 31; Indonesia 15.
Other:			
Nonlubricating oils, n.e.s do	3	8	United States 5; Netherlands 1.
Pitch do	(1)	1	Mainly from United Kingdom.
Bituminous mixtures, n.e.s do	1	1	Mainly from United States.
Unspecified do	r (1)	(1)	All from United States.
Total do	r 3,053	3,581	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	3,798	1,193	United States 470; Netherlands 429; United Kingdom 270.

r Revised.
1 Less than ½ unit.
2 Revised to none.

COMMODITY REVIEW

METALS

Copper.—Production of copper increased significantly over the depressed level of 1975 owing primarily to the coming onstream of the new Cuajone project after nearly 10 years of effort and construction. The record high level, representing 3% of world production, ranked Peru 10th as a world producer. In value, copper exports represented 30% of Peru's total mineral exports.

SPCC was the main copper producer, operating the Toquepala and Cuajone open pit mines. At Toquepala, in production since 1960, mine output of copper increased 21% to 14.5 million tons, with an average ore grade of 1.05%. Initial mine production at Cuajone, located 16 kilometers from Toquepala, was 10.4 million tons, composed of sulfide ore grading 1.61% and oxide ores grading 0.98% to 3.98%. Full output from Cuajone of 156,000 tons of copper was expected in 1977. Estimated milling-grade ore reserves for Toquepala and Cuajone at yearend totaled 630 million tons of ore with an average grade of just under 1%.

Mine operations at Cuajone during 1976 involved a combination of pre-mine stripping, pit preparation for production of ore, and production mining. Copper ore began moving to the concentrator during the second quarter of the year. By yearend, capital expenditures for Cuajone amounted to $666 million, including land and net startup expenses. Total estimated project development costs increased to $675 million from the estimate of $355 million in mid-1969.

Minero Peru's only new mine development project, Cerro Verde, was in the final stage of construction at yearend, with 73% of construction work completed and $198 million invested. In stage I, Minero Peru planned to exploit 60 million tons of oxide

and mixed ores, of which 30 million tons was high-grade oxide ores. Initially, 33,000 tons of copper cathodes was to be produced. The feasibility study for stage II, involving the large adjacent sulfide deposit, was completed by Ralph M. Parsons Co. which indicated that an investment of $1.3 billion would be required to produce 165,000 tons of copper per year.

A commission composed of SPCC and Minero Peru was studying the possibilities of a joint venture through a special mining company to develop the Quellaveco deposit. Reserves at Quellaveco are estimated at 388 million tons of 0.85% copper. Since Quellaveco is equidistant from the Toquepala and Cuajone mines, its development could take advantage of existing infrastructure.

A feasibility study was completed on the Antamina copper deposit located north of Lima in the Province of Huari, Department of Ancash, at an altitude of 14,000 feet. This deposit will be developed by Antamina Special Mining Co., formed in January 1974 and owned 51% by Minero Peru and 49% by Geomin of Romania. The complex copper-zinc ore, estimated at 121 million tons, contains 1.56% copper, 1.27% zinc, 0.51 troy ounce of silver per ton, and 0.04% molybdenum. The $358 million project was designed to produce copper and zinc concentrates containing 75,000 tons and 59,280 tons per year, respectively, and 3,000 tons per year of molybdenum concentrate. Transportation will be by a 380-kilometer pipeline to the port of Huacho. Construction was estimated to require 5 years (1977–81).

In late 1976, SPCC completed expansion of its smelter at Ilo from 126,000 tons to 290,000 tons per year of blister copper, to provide capacity for treating the new Cuajone output. Initial output from Cuajone, in the form of fluxing ore, was received at the Ilo smelter in July 1976.

Minero Peru's Ilo refinery produced 94,000 tons of copper cathodes in 1976. Minero Peru decided to engage in a turnkey contract with Mitsui Mining & Smelting Co., Ltd., and Furukawa Mining Co., Ltd., to expand its Ilo refinery from 150,000 tons to 300,000 tons per year of copper. Financing entirely by Japan was arranged to cover the estimated cost of $84.5 million.

One of Centromin's priority projects was the rehabilitation and expansion of the copper smelter and refinery at the La Oroya complex, parts of which date from 1922. Capacity to produce refined copper was to be expanded from 58,000 tons to 80,000 tons per year at an estimated cost of $140 million. Financing was being sought in Canada and the United Kingdom.

Indium.—Indium was recovered by Centromin at the La Oroya metallurgical complex, primarily from lead and zinc concentrates. Centromin's output increased 106% over the depressed level of 1975 to almost 3,000 kilograms. Peru ranked fourth in world reserves of indium and accounted for 15% of U.S. imports.

Iron Ore.—Production of iron ore and concentrate by Hierro Peru declined sharply in 1976, owing mainly to marketing problems following nationalization of Marcona Mining Co.'s operation in 1975 and the continued worldwide recession affecting iron ore purchases. About 400,000 tons of the iron ore output was shipped to Peru's major steel plant at Chimbote. Exports of iron ore, Peru's fourth most valuable mineral export, were at the depressed levels of 1975, although earnings were 27% higher. In 1976, Hierro Peru shipped through Minpeco 3,250,000 tons of iron ore to world markets. It was reported that sales contracts were arranged in the nontraditional markets of Argentina, Romania, and Yugoslavia.

Since the Marcona nationalization, exports of Peruvian iron ore to Japan had been discontinued. In April, Minpeco signed a contract with Nippon Steel to supply pellets and pellet feed. In mid-1976, Minpeco signed a long-term contract with Kobe Steel for the export of pellet feed. Under the contract, Peru will export a total of 5.8 million tons during a period of 7 years and 3 months.

In response to market demand for a higher quality pellet having a lower sulfur content, Hierro Peru entered into a contract with Lurgi S.A. to study a new pelletization process. Plans were underway to expand the pellet plant from 4.0 million tons to 7.5 million tons, and relevant conversations were opened up with a Japanese consortium for financing.

In September, agreement was reached on compensation for the nationalization in July 1975 of Marcona's assets. The total compensation package equivalent to about $61

million included a cash payment, a freight contract, and a 4-year sales contract between Minpeco and Marcona whereby Marcona will purchase 3.7 million tons of pelletized iron ore for resale exclusively in the U.S. market.

Iron and Steel.—Production of raw steel declined again in 1976 by 19%. Empresa Siderúrgica del Perú (Siderperu) completed expansion of its steelworks at Chimbote from 425,000 tons to 700,000 tons of crude steel per year. A 100,000-ton-per-year tinplate line was installed at Chimbote by Mitsubishi Heavy Industries, Ltd. Siderperu was planning to increase annual steel capacity to 2.3 million tons by 1982 and 4 million tons by 1990 in order to meet national demands until the year 2000.

Lead.—Two new lead-zinc mines in the medium-scale mining sector were reported to have come onstream: El Farallon, located in the Province of Huarochiri, Department of Lima; and El Extrano, located in the Province of Yungay, Department of Ancash. Important lead producers in the medium-scale mining sector were Cia. Minera Atacocha S.A., Cie. des Mines de Huaron, Cia. Minera Milpo S.A., Cia. Minera Raura S.A., and Cia. Minera Santa Luisa S.A.

The contract signed by Centromin with Kaiser Engineers in November 1975 to provide engineering services for the new lead sinter plant at La Oroya did not become operative because of delays in arranging financing. Centromin was seeking financing for the lead sinter project estimated to cost $265.5 million.

Molybdenum.—SPCC was the major producer of molybdenum concentrate as a byproduct of its copper operations. In 1976, SPCC had a slight decrease in production of concentrate to 402 tons (metal content). Cia. Minera Turmalina and Cia. Minera San Diego were smaller producers of molybdenum concentrate. Peruvian reserves ranked fourth worldwide.

Rhenium.—Rhenium was recovered in West Germany and Sweden as a byproduct of the roasting of molybdenite concentrate imported from Peru. The 1976 output of rhenium attributed to Peru was estimated at 180 kilograms of metal. Worldwide, Peru ranked fifth in both production and re-

Silver.—Silver production increased significantly in line with increases in copper, serves of rhenium.

lead, and zinc output. Silver exports in 1976, valued at $149 million, continued to rank third after copper and zinc as Peru's most valuable mineral export. A medium-size mine, Puquio Cocha, ceased operations in 1976 because of depletion of reserves.

Uranium.—Peru's Nuclear Power Institute was studying plans for a trial plant to extract uranium from copper and lead ores from mines in the Andean Range. Depending on results, larger scale exploitation of uranium may be undertaken.

The Government and the International Atomic Energy Agency were planning a 5-year program to develop Peruvian uranium resources and establish nuclear power reactors.

Zinc.—In October, Centromin signed an agreement with Surveyer, Nenninger and Chenevert Inc. of Montreal to provide project management for the rehabilitation and expansion of the zinc circuit at La Oroya from 70,000 tons to 90,000 tons per year. In November, loan agreements wre signed with the Export Development Corporation and the Royal Bank of Canada for partial financing of the project estimated to cost $62.5 million. Construction of the civil works continued.

Following approval by the Government, Minero Peru signed a contract with Syndicat Belge d'Entreprises S.A. (SYBETRA) in November 1976 for construction of a $200 million zinc refinery at Cajamarquilla in Rimac Valley near Lima. The refinery will have an annual capacity of 200,000 tons of concentrates with an annual recovery of 101,500 tons of refined zinc, 176,000 tons of sulfuric acid, 335 tons of cadmium, and 16,630 tons of lead-silver residues. The refinery, scheduled for startup in 1980, was a high-priority project of Minero Peru. At yearend, all infrastructure works had been contracted and preliminary civil works initiated.

NONMETALS

Barite.—Peru continued as the leading producer of barite in Latin America and ranked seventh worldwide.

Fertilizer Materials.—The original plan for mining the Bayóvar phosphate deposit, located in northern Peru, was expanded by Minero Peru to include production of compound fertilizers. A total investment of $200

million was required to produce 150,000 tons of diammonium phosphate and 370,000 tons of triple superphosphate per year.

In December, Minero Peru signed an agreement with Spain's Instituto Nacional de Industria through its Empresa Nacional Adaro de Investigaciones Mineras S.A. (ENADINSA) to carry out and finance a feasibility study over a 10-month period. Upon completion of the study, ENADINSA plans to form a special mining company to exploit the phosphate desposit, totally with Spanish financing.

MINERAL FUELS

Peru's energy consumption and dependency situation are shown in tables 5 and 6.

Coal.—In April, Electricidad del Perú (Electroperu) and Minero Peru signed a contract with a joint venture of Kopex of Poland and Universal Engineering of Switzerland to carry out a technical-economic study, estimated to cost $1.8 million, of the Alto Chicama coal mine and energy complex. The Alto Chicama deposit lies 480 kilometers north of Lima and east of Trujillo.

The project in the first stage includes construction of a thermoelectric plant with a capacity of 200 megawatts and a mine complex to produce 2,000 tons of coal per day. In the second stage, capacity will be increased to 480 megawatts requiring 4,200 tons per day of coal output. The project is expected to be operational by 1982. The plant will supply energy for the proposed Michiquillay copper project and the proposed fertilizer-petrochemical complex at Bayóvar. Measured coal reserves at Alto Chicama were estimated at 50 million tons of anthracite. Inferred Alto Chicama reserves were 250 million tons.

Based on geologic studies and limited mining data, Peru's total coal reserves have been estimated at 1.06 billion tons, classified as follows: 830 million tons anthracite, 130 million tons bituminous, and 100 million tons lignite. Of this total, 130 million tons was considered to be of coke-making quality. Details on the coal areas studied are provided in table 7.

Table 5.—Peru: Primary energy consumption

(Thousand tons of standard coal equivalent [1])

Type of energy	1965		1970		1976		Annual average percentage increase
	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	
Petroleum	4,293	60.9	5,826	65.2	8,184	68.2	6.0
Wood	1,077	15.3	1,257	14.1	1,456	12.1	2.8
Hydropower	410	5.8	587	6.6	880	7.3	7.2
Natural gas	722	10.2	657	7.3	762	6.4	.5
Bagasse	516	7.3	550	6.2	657	5.5	2.2
Coal	32	.5	53	.6	57	.5	5.5
Total [2]	7,049	100.0	8,930	100.0	11,995	100.0	5.2

[1] 1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.
[2] Data may not add to totals shown because of independent rounding.

Source: Montalvan, H. Energy Sector in Peru, Actual Situation and Perspectives. Energy Planning Office, Ministry of Energy and Mines. Pres. at meeting on Energy Planning in Developing Countries, Center for Natural Resources, Energy, and Transportation, United Nations, New York, November 1977, pp. 6 and 8.

Table 6.—Peru: Dependence on primary energy imports

(Thousand tons of standard coal equivalent [1])

Year	Imports	Consumption	Imports as percentage of consumption
1965	236	7,049	3.3
1970	1,126	8,930	12.6
1975	3,379	11,838	28.5
1976	3,309	11,995	27.6

[1] 1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.

Source: Montalvan, H. Energy Sector in Peru, Actual Situation and Perspectives. Energy Planning Office, Ministry of Energy and Mines. Pres. at meeting on Energy Planning in Developing Countries, Center for Natural Resources, Energy, and Transportation, United Nations, New York, November 1977, pp. 6 and 8.

Table 7.—Peru: Coal deposits, 1976

Area	Thickness of seam (meters)	Moisture (percent)	Volatile matter (percent)	Ash (percent)	Fixed carbon (percent)	Calorific value (kilocalories per kilogram)	Inferred reserves (million metric tons)	Nearest port and distance (kilometers)
Oyon	1–2	6	6–22	5–12	54–70	7,000–7,600	68	Huacho, 150.
Carumas	.5–2.2	3–5	9–38	3–5	54–70	NA	3	Ilo, 220.
Yanacancha	NA	8–12	28–30	8–14	40–50	7,000	25	Pacasmayo, 230.
Pinipata	.8–2.2	4–5	4–8	6–35	53–84	6,414–7,629	50	NA.
Cupisnique	1–2.2	4–6	4–8	8–12	70–80	6,000–7,500	24	Pacasmayo, 50.
Alto Chicama	.25–6	5–8	2.5–12	6–10	80–85	7,000–7,500	[1] 300	Salaverry, 100–160.
Santa	.4–7	4–6	3–6	7–12	80–85	6,000–7,500	200	Chimbote, 110.
Jatunhuasi	.2–.4	6–10	32–38	6–20	40–60	5,000–7,000	60	Callao, 340.
Tarica-Sihuas-Conchucos	1.4–1.6	4–7	4–6	6–14	NA	6,000–7,300	80	Chimbote, 160.
San Marcos-Huallanca	1–2	NA	NA	NA	NA	NA	50	Callao, 440.
Tumbes	1–4	9–18	27–32	20–36	20–30	2,700–4,300	100	Talara, 150.

NA Not available.
[1] Includes measured reserves of 50 million metric tons.

Sources: Ratto, J. Reservas Carboniferas Peruanas (Peruvian Coal Reserves), Mexico City. Paper presented at ILAFA—Coal Congress. July 1976.

Petroleum.—Although production of crude oil increased 6% to 76,500 barrels per day, Peru continued to rely heavily on imports to meet domestic demand. Of the 41.5 million barrels of crude oil processed in 1976 in Peru's five refineries, 40% was imported—75% from Ecuador, 21% from Venezuela, and 4% from Colombia. Details on crude oil processed in 1976 are given in table 8.

The Government was forced to increase the price of petroleum products twice in 1976. Regular motor gasoline was increased in price first 53% and then 117% to about $0.90 per gallon. Domestic sales of petroleum products increased only 2% in 1976.

Crude oil production during 1976 came from the northwestern coast (43%), the continental shelf (42%), and jungle areas (15%). Production from the coastal area continued its downward trend, experiencing a further 7% decrease. Production from the continental shelf by Belco increased 12%. Petroperu and Occidental continued to be the only producers in the jungle areas from the Trompeteros and Shiviyacu oilfields, respectively, where crude oil production continued its upward trend during 1976, increasing 43% from 3.0 million barrels in 1975 to 4.3 million barrels in 1976. The major part of Occidental's production was shipped to Brazil.

Petroleum developments were marked by two major events: Completion of the 853-kilometer trans-Andean pipeline and reopening of offshore and jungle areas for new exploration and production contracts.

The trans-Andean pipeline from Jose de Saramuro in the Department of Loreto to Bayóvar on the coast was completed in December after 2 years of difficult and uninterrupted construction work. The pipeline was expected to initially transport 40,000 barrels per day by early 1977; by yearend, Peru was expected to decrease its imports of crude oil to 10,000 barrels per day. In September 1976, Petroperu signed a $108 million contract with a Mexican firm, Constructora Protexa S.A. de C.V., to construct the 250-kilometer spur pipeline from Occidental's oilfields to the trans-Andean pipeline. Completion of the spur was expected in April 1978.

Peru's crude oil production was expected to increase to 140,000 barrels per day in early 1978 and to 170,000 barrels per day in September 1978 when the entire pipeline complex would be in operation. Peru was then expected to achieve self-sufficiency and resume exports, which were discontinued in 1963.

The reopening of the offshore and jungle areas to operations contracts was announced in July 1976, but by yearend, the frame of reference governing the contracts had not been published; consequently, no new operating contracts were negotiated in 1976.

No major oil discoveries were made during 1976. Total proven reserves were estimated at 750 million barrels. By yearend, all areas devoted solely to exploration, with the exception of that assigned to Oceanic, had reverted to Petroperu. Occidental was the only foreign operator in the jungle areas. Petroperu continued exploration and production activities in the jungle areas.

Refinery capacity at the five refineries in Peru totaled 123,300 barrels per day in 1976. The La Pampilla refinery was undergoing expansion that would increase its capacity 65,000 barrels per day. When it is completed in mid-1977, Peru's refinery capacity will have increased to 188,300 barrels per day.

Table 8.—Peru: Crude oil processed in 1976

Refinery	Capacity (barrels per day)	Crude oil processed (thousand 42-gallon barrels)			
		Domestic	Imported	Total	Percent of total
Talara	75,000	23,004	2,560	25,564	61.6
La Pampilla	37,000	711	11,428	12,139	29.2
Conchán	8,000	71	2,701	2,772	6.7
Pucallpa	2,200	656	--	656	1.6
Iquitos	1,100	380	--	380	.9
Total	123,300	24,822	16,689	41,511	100.0

The Mineral Industry of the Philippines

By K. P. Wang [1]

The Philippine economy did not have a particularly good year in 1976, but it was better than in 1975. Real gross national product (GNP) growth was 6.3% in 1976, compared with 5.9% in 1975. The 1976 trade deficit was slightly over $1 billion[2] and the current account deficit was $565 million, nearly the same as that of the previous year. However, favorable capital flows reduced the overall deficit to $164 million, a marked improvement over the previous year's $520 million deficit. Inflation was held down to a modest rate of 6.2%.

At current prices, the Philippine GNP reached about $17.5 billion in 1976 compared with $15.7 billion (revised) in 1975. In terms of constant 1972 prices, the GNP attained respectively $9.75 billion and $9.42 billion, which equates to the 6.3% real growth. The sectors were led by construction which posted a 22% increase, much lower than the 1975 growth of 52% when office and hotel construction reached peak levels. Agriculture, fisheries, and forestry showed a 5.7% growth with high inputs from sugarcane, livestock, and forestry. Manufacturing expanded at 5.6%, with export processing and construction as important sources of stimulation. Mining managed a 2.4% boost in real growth with the modest recovery of copper prices.

A lower level of gross domestic capital formation in 1976 precluded a faster growth rate. Specifically, expenditures for private construction, which at 54% led all other GNP expenditure components in 1975, dipped to 20.3% in 1976. This slowdown was traceable to the completion during the year of several construction projects.

Mineral output value of the Philippines at about $620 million corresponded with 3.5% of the 1976 GNP. Value added for refined materials and metals has not been included, although this is relatively small for the Philippines. Minerals and metals are considerably more important in overall trade, constituting approximately one-fourth of overall exports in 1976. Moreover, 70% by value of all minerals produced were exported. In the case of imports, mineral fuels (mainly oil) alone represented one quarter of all imports in 1976, and base metals added another 6.7%. Purchases of fuels and metals have contributed heavily to the adverse balance-of-payments position of the Philippines.

The country has always been considered fairly rich in minerals, particularly copper. According to the Philippine Bureau of Mines, proven copper reserves in 1976 were sufficient for at least 50 years at present extraction rates, and estimated reserves were three times as much, or 2.9 billion tons of porphyry ore. Understandably, various producers have expansion programs underway and more will be done in this regard under high-price conditions. The gold potential was considered good also, but low gold prices were holding back expansion. Philippine chromite is world famous; however, production was down in 1976 because of sluggish demand by the world steel producers. Nickeliferous laterites may be abundant, but the infant

[1] Supervisory physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Philippine pesos (P) to U.S. dollars at the rate of P7.44 = US$1.00 for 1976 and P7.25 = US$1.00 for 1975.

nickel smelting industry encountered more than the usual startup difficulties during the year. Mining of iron sands was expected to be not only resumed but also expanded. A new magnetite iron mine, located in Cagayan, Northern Luzon, was in the embryo stage of development. Extraction of mercury temporarily ceased, and manganese mining was resumed. In contrast, output of lead and zinc increased. The important cement industry continued to expand, and construction of the country's first perlite processing plant commenced.

The Atlas Consolidated Mining and Development Corp., the country's most famous mining company with principal operations on Cebu Island, grossed $157.7 million in 1976 and netted $25.4 million in profits. It produced 103,053 tons of mine copper, 73,258 troy ounces of gold, and 83,393 tons of pyrite in 1976, and reported reserves of 880 million tons of ore averaging 0.46% copper. Marcopper Mining Corp., with mines in Marinduque, grossed $50.8 million, netted $8.5 million in profits, and produced 47,534 tons of mine copper. Philex Mining Corp. produced only 30,641 tons of mine copper in 1976 along with 189,946 troy ounces of gold—the most in the Philippines. This explains why this Baguio-based firm grossed $60.1 million and realized a profit of $20 million during the year.

Lepanto Consolidated Mining Co. grossed $37.5 million in 1976 but showed only $1.8 million in profits from its Mankayon mine near Baguio which had shut down temporarily because traditional buyers could not handle its enargite ore. Lepanto had been a very important producer of high-gold-content copper ore. Benguet Consolidated Inc. suffered a small net loss in 1976 because of low gold prices. Its efforts to diversify still had not met with enough success to compensate for the gold dilemma. Marinduque Mining & Industrial Corp. had a $120.4 million gross but an $11.1 million deficit. Its copper mines, mainly Sipalay on the Negros which has reported ore reserves of 650 million tons analyzing 0.49% copper, made good profits in 1976, whereas its nickel operation in Surigao suffered losses and even forced Marinduque to obtain short-term loans. The previous account stresses the fact that the copper industry did all right whereas most other metal mining industries did not fare too well in 1976.

Under Martial Law, the Philippine mining industry attained considerable stability during the last few years. More controls were introduced but there was also more flexibility in the laws to help industries in trouble. For example, export duties for copper and gold were withdrawn. The depressed gold industry was able to obtain loans, although the hope was to obtain subsidies. Taxation was a percentage of gross rather than net profit. The new industry tax holiday was temporarily revoked. Savings in corporate tax was made possible through declaration of stock dividends. Percentage depletion was phased out, and cost depletion was introduced. The Government was considering reduction of allowable exploration and development costs. Various tax incentives under the Investment Incentive Act and Exports Incentives Act were created in an attempt to create a better mining investment climate. Foreign participation in joint ventures was encouraged, with equity share allowable still at no more than 40% and no less than 25%.

The Philippine Board of Investment made the announcement that mining accounted for one-third of the 806 million pesos ($108 million) worth of planned investment application made in the first half of 1976, almost equalling the total for 1975. The substantial increase was taken to reflect a better outlook for minerals and metals, with export prospects generally regarded as bright.

The country was made more attractive to foreign investors upon the promulgation of Presidential Decree 87 in 1976 which provided incentives in the form of exemptions from duties and taxes on machinery and equipment, repatriation of capital, and retention of remittances abroad of all foreign exchange earnings. As a further incentive, a plan was suggested to award exclusive geophysical contracts over onshore and deep offshore areas and to give the contractor first option as operator of resulting service contracts.

The Philippine electric power base did not show great change. Installed power capacity in 1976 was about 3.2 million kilowatts, which was two-thirds thermal (mainly diesel-fired) and one-third hydro, and two-thirds public and one-third indus-

trial. Overall electricity output increased possibly 1 billion kilowatt-hours, to 15 billion kilowatt-hours in 1976. Half of this was produced by Mesalco Co., and 20% by the National Power Corp. Scattered sources of geothermal power were investigated during 1976, and construction of a 3,000-kilowatt plant at Ormac, Leyte, was underway. In a further effort to diversify the energy base, the Government-owned National Power Corp. signed the country's first nuclear power contract on February 9, 1976, with Westinghouse Corp., for building a 620,000-kilowatt plant in Bataan by 1982. The plant will cost as much as $1.2 billion eventually but a source of uranium was still not obtained by early 1977.

PRODUCTION

Due to increases in base metal prices in 1976, the major metals led by copper, nickel, cobalt, lead, zinc, and metallurgical chrome registered significant gains, thereby reversing the sluggish trend in earlier years. Cement production continued to increase. Overall mineral production value increased from 3.9 billion pesos in 1975 to 4.6 billion pesos in 1976, compared with 4.5 billion pesos in 1974.[3]

The year 1976 saw the recovery of copper output, which has long since supplanted gold as the leading mineral product of the Philippines. Copper production value increased from 1.64 billion pesos in 1975 to 1.91 billion pesos in 1976. Gold output value declined 24% from 575 million pesos registered in 1975, owing to the price drop from about $160 per troy ounce to $125 per troy ounce in 1976 despite maintaining the same production level. Actually, cement has been the No. 2 mineral product of the Philippines during the last few years, and output value in 1976 was 1.04 billion pesos. In value, nickel spurted past gold registering 600 million pesos in 1976. The nickel industry still had startup difficulties and suffered severe financial losses, despite doubling the quantity of production. Refractory chromite was down 26% in tonnage but only 4% in value to 91 million pesos in 1976. Iron concentrate dropped from 91 million to 39 million pesos, but mine zinc increased from 32 million to 39 million pesos and metallurgical chromite increased from 21 million to 29 million pesos in 1976. Salt production was stable, at 68 million pesos for both 1975 and 1976.

On a world scale, the Philippines produced only five items of note. In 1976, chromite output was 5% of the world total, and the country has always been prominent in refractory chromite. The Philippines is a medium-size producer of copper, nickel, and gold, with 1976 output representing respectively 2.9%, 2.3%, and 1.3% of the world total. Cement was about 0.6% of world production. Generally the Philippines is well known for metals, particularly porphyry copper, gold, and nickeliferous laterites.

[3] The peso was valued at 13.4, 13.8, and 14.6 U.S. cents, respectively, in 1976, 1975, and 1974.

Table 1.—Philippines: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1676 p
METALS			
Cadmium mine output, metal content	--	15	--
Chromium, chromite, gross weight:			
Metallurgical grade	100,415	98,986	117,358
Refractory grade	429,132	421,052	310,302
Total	529,547	520,038	427,660
Cobalt mine output, metal content	--	106	594
Copper mine output, metal content	225,542	225,775	238,146
Gold ---troy ounces	537,624	501,793	501,197
Iron and steel:			
Iron ore and concentrate ---thousand tons	1,608	1,351	571
Ferroalloys	2,213	e 2,200	e 2,200
Lead mine output, metal content	1,303	3,388	4,580
Manganese ore and concentrate, gross weight	857	--	10,576
Mercury mine output, metal content ---76-pound flasks	812	244	--
Molybdenum mine output, metal content	--	15	--
Nickel mine output, metal content	326	9,500	15,239
Platinum-group metals:			
Palladium ---troy ounces	2,315	836	--
Platinum ---do	1,350	579	--
Silver mine output, metal content ---thousand troy ounces	1,734	1,620	1,513
Zinc mine output, metal content	7,772	10,453	11,410
NONMETALS			
Barite	--	3,803	3,199
Cement, hydraulic ---thousand tons	3,503	4,264	4,375
Clays:			
Bentonite	--	661	2,117
Red	16,955	18,267	8,284
White	26,701	8,102	12,267
Rock	5,002	756	1,498
Other	1,228,934	442,658	475,155
Feldspar	10,245	3,907	15,246
Fertilizer materials:			
Crude, phosphatic:			
Guano	13,552	125,813	2,253
Phosphate rock	26,506	5,401	11,703
Manufactured:			
Nitrogenous e 1	53,500	53,400	57,000
Mixed and unspecified	79,126	NA	NA
Gypsum and anhydrite, crude 2	126,126	117,983	61,700
Lime	101,262	35,728	27,086
Perlite	1,131	665	1,649
Pyrite and pyrrhotite (including cupreous), gross weight	164,618	161,560	166,331
Salt, marine	213,644	202,060	203,983
Sand and gravel:			
Alumina sand	8,596	28,282	NA
Sand, glass ---thousand tons	689	427	NA
Other 3 ---thousand cubic meters	2,161	5,265	4,974
Stone:			
Coral, crushed ---do	57	157	163
Dacite	23,923	22,866	NA
Diorite	56,226	86,325	NA
Dolomite	11,677	5,832	6,432
Limestone ---thousand tons	6,588	5,806	6,821
Marble (dimension), unfinished	6,529	11,805	4,104
Tuff	59,296	49,165	77,123
Cobbles and boulders, n.e.s ---thousand cubic meters	227	47	482
Sulfur	76,547	75,125	77,344
Talc	2,333	1,342	1,411
MINERAL FUELS AND RELATED MATERIALS			
Coal, all grades	50,746	105,128	111,584
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	14,369	16,294	15,381
Jet fuel ---do	2,060	2,391	2,353
Kerosine ---do	2,822	3,259	2,991
Distillate fuel oil ---do	11,959	13,526	14,148
Residual fuel oil ---do	20,607	23,815	25,149
Other ---do	2,643	3,013	3,118
Refinery fuel and losses ---do	3,759	3,531	3,314
Total ---do	58,219	65,829	66,454

e Estimate. p Preliminary. NA Not available.

1 Data are for years ending June 30 of that stated.

2 Includes synthetic.

3 Includes unspecified earths.

TRADE

Total trade in 1976 was about $6.2 billion, compared with $5.8 billion in 1975. The trade deficit was cut down, although still large. Imports increased 5%, from $3.46 billion in 1975 to $3.63 billion in 1976, but exports increased 12% from $2.29 billion to $2.57 billion. The foremost import items were mineral fuels 24.5%, machinery other than electrical 17.2%, transport equipment 7.6%, base metals 6.7%, electrical machinery 5.2%, cereals 5.2%, and chemicals 3.9%. By value, Japan accounted for 27% of the Philippines' total imports, followed by the United States 22%, the Organization of Petroleum Exporting Countries (OPEC) 17%, and European Economic Community (EEC) countries 12%.

Philippine exports are tied to the economies of the industrialized nations. The world situation improved in 1976, but industrial demand became sluggish later in the year adversely affecting export prices for Philippine products.

Sugar was the leading export item in 1976, accounting for 16.6% of total exports. Next came coconut oil 11.5%, copper concentrates 10.3%, copra 5.8%, logs 5.3%, bananas 2.9%, lumber 2.6%, copra oil cake 2.1%, gold 1.9%, pineapples 1.8%, and plywood 1.7%. Principal export destinations were the United States 35.6%, Japan 24.2%, and EEC 18.8%. Mineral exports were valued at 3.24 billion pesos ($435 million), an increase of 14.4% (in pesos) over the 2.84 billion pesos ($392 million) in 1975. Copper exports registered 1.85 billion pesos ($249 million) in 1976, 85% of which went to Japan. Gold exports reached 381 million pesos ($51 million). Exports of refractory chromite were down considerably, to 66 million pesos ($8.9 million). However, exports of metallurgical chromite increased significantly to 86 million pesos ($11.6 million).

Table 2.—Philippines: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	4,253	2,081	Japan 960; Hong Kong 558; Oman 415.
Chromium, chromite ore and concentrate	641,817	501,350	United States 188,386; Japan 158,131; United Kingdom 37,486.
Copper:			
Ore and concentrate	861,306	816,333	Japan 698,626.
Metal including alloys:			
Scrap	2,235	100	All to Spain.
Matte	25	8	All to Sweden.
Unwrought and semimanufactures	(1)	--	
Gold:			
Bullion ---thousand troy ounces	167	155	All to United Kingdom.
Metal, rolled, unworked or partly worked ---do	374	335	Japan 248; United States 42; People's Republic of China 35.
Iron and steel:			
Ore and concentrate ---thousand tons	1,121	1,305	All to Japan.
Roasted pyrite ---do	5	17	Taiwan 12; Indonesia 5.
Scrap	450	--	
Metal, semimanufactures:			
Bars, rods, angles, shapes, sections	4	10	All to Australia.
Universals, plates, sheets	1	7	Japan 4; Thailand 2.
Hoop and strip	10	--	
Wire	6	--	
Tubes, pipes, fittings	665	1,739	Indonesia 1,330.
Castings and forgings	103	226	Canada 187; People's Republic of China 21.
Lead:			
Ore and concentrate	769	3,735	All to Japan.
Metal including alloys, unwrought and semimanufactures	3	2	Mainly to Hong Kong.
Manganese ore and concentrate	2,127	1,518	All to Taiwan.
Mercury ---76-pound flasks	250	--	
Molybdenum ore and concentrate	17	32	West Germany 20; United States 12.
Nickel:			
Ore and concentrate	2,437	225	All to Japan.
Metal including alloys, all forms	--	6,953	United States 4,938; Netherlands 1,322.
Silver metal including alloys, unworked and partly worked:			
Silver, including silver gilt and platinum-plated silver ---thousand troy ounces	201	63	All to United Kingdom.
Rolled ---do	311	242	Hong Kong 241.
Zinc:			
Ore and concentrate	14,216	14,778	Japan 11,698; United States 3,080.
Metal including alloys:			
Scrap	436	354	Japan 264; Taiwan 90.
Unwrought and semimanufactures	5	(1)	All to Singapore.
Other:			
Ores and concentrates, n.e.s	9,929	3,700	United States 3,200; Canada 500.
Ash and residue containing nonferrous metals	532	8,120	United Kingdom 7,179.
Base metals including alloys, all forms, n.e.s	2	1	Mainly to United States and Japan.
NONMETALS			
Asbestos	83	--	
Cement, hydraulic	756,697	777,074	Indonesia 199,830; Bangladesh 192,325; Saudi Arabia 77,100.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s	104	10	All to Taiwan.
Products, nonrefractory value, thousands	$4,854	$2,744	Singapore $1,073; Hong Kong $528.
Feldspar and fluorspar	1	--	
Fertilizer materials:			
Manufactured, mixed	--	4	All to Thailand.
Ammonia	3	--	
Pyrite	70,721	37,076	All to Japan.
Salt	72	(1)	All to United States.

See footnote at end of table.

Table 2.—Philippines: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked, unspecified	102	14	Mainly to United States.
Worked:			
Marble	756	284	Japan 131; Australia 57.
Other	26	1	All to Hong Kong.
Gravel and crushed stone	2	--	
Quartz and quartzite	9,800	7,200	Japan 6,200; Taiwan 1,000.
Sand:			
Natural (river and sea)	279	388	United Kingdom 88; Italy 82; Netherlands 59.
Silica	101	--	
Other	1	--	
Sulfur, sulfuric acid	2,100	82	All to United States.
Other nonmetals, n.e.s.:			
Crude	701	440	Indonesia 242; Taiwan 150.
Oxides and hydroxides of magnesium, strontium, barium	1	--	
Slag, dross and similar waste, not metal bearing	4,550	4,200	All to Taiwan.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	10	--	
Carbon black	162	231	Indonesia 199; Taiwan 32.
Hydrogen and other rare gases	2	3	All to Indonesia.
Petroleum refinery products:			
Gasoline:			
Aviation—thousand 42-gallon barrels	2	1	All to United States.
Motor ——do——	74	346	United States 133; Singapore 121; Hong Kong 92.
Kerosine and jet fuel ——do——	239	372	United States 146; Indonesia 99; United Kingdom 50.
Distillate fuel oil ——do——	359	525	United States 380; Indonesia 54.
Residual fuel oil ——do——	227	605	Singapore 447; United Kingdom 117.
Lubricants ——do——	61	189	Singapore 187.
Other:			
Liquefied petroleum gas ——do——	39	--	
Mineral jelly and wax ——do——	[1]	--	
Asphalt ——do——	39	38	United States 37.
Unspecified ——do——	4	3	All to United States.
Total ——do——	1,044	2,079	

[1] Less than ½ unit.

Table 3.—Philippines: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite ore and concentrate	5,681	7,589	All from Malaysia.
Metal including alloys:			
Scrap	212	49	Japan 37; United States 12.
Unwrought	18,393	8,458	United States 5,171; Australia 1,468.
Semimanufactures	2,246	2,180	Japan 749; France 313; Italy 101.
Arsenic trioxide, pentoxide, acids	98	108	West Germany 45; France 35; United States 22.
Chromium oxide and hydroxide	115	74	West Germany 36; France 10; Italy 10.
Cobalt oxide and hydroxide	2	1	Mainly from Belgium-Luxembourg and Japan.
Copper:			
Copper sulfate	57	61	Belgium-Luxembourg 20; Japan 13; West Germany 13.
Metal including alloys:			
Unwrought	4,782	3,405	United States 1,479; Japan 1,444.
Semimanufactures	3,634	2,787	Japan 1,595; Australia 462.
Gold leaf and gold foil ---troy ounces	48	4	United States 3.
Iron and steel metal:			
Scrap	17,316	61,363	United States 45,284; Hong Kong 6,700; Japan 5,954.
Pig iron, cast iron, powder, shot	46,303	28,376	North Korea 21,695; Australia 3,457.
Ferroalloys	10,861	3,018	Taiwan 1,697; Japan 627; United States 257.
Steel, primary forms	555,535	286,609	Japan 141,619; Australia 112,745.
Semimanufactures:			
Bars, rods, angles, shapes, sections	84,650	64,282	Japan 46,574.
Universals, plates, sheets	164,515	178,973	Japan 168,913.
Hoop and strip	r 28,178	15,553	Japan 7,846; Australia 7,023.
Rails and accessories	3,807	11,309	Japan 9,851.
Wire	17,030	11,460	Japan 9,340; Australia 889.
Tubes, pipes, fittings	20,884	28,417	Japan 24,116; United States 1,483.
Castings and forgings	233	93	United States 81; Hong Kong 7.
Lead:			
Oxides	66	37	United States 27; Australia 9.
Metal including alloys, all forms	4,867	7,110	Australia 4,289; Japan 2,171.
Magnesium metal including alloys, all forms	29	12	United States 8; Japan 4.
Manganese:			
Ore and concentrate	1,192	2,571	United States 2,400.
Oxide and dioxide	1,370	1,139	Japan 487; United States 371; India 100.
Mercury ---76-pound flasks	r 5	159	U.S.S.R. 150.
Molybdenum:			
Ore and concentrate	35	--	
Metal including alloys, all forms	147	62	United States 47; Canada 10.
Nickel metal including alloys, all forms	234	100	West Germany 20; United States 18; Japan 11.
Platinum and platinum-group metals, unwrought and semimanufactures ---troy ounces	3	2	All from United Kingdom.
Silver:			
Silver leaf and silver foil ---do	5,680	1	All from United States.
Silver, including silver gilt and platinum-plated silver, unwrought and semimanufactures ---do	--	526	United States 500.
Tin:			
Oxides	(1)	2	Australia 1; United States 1.
Metal including alloys, all forms	1,020	302	Malaysia 252; Australia 30.
Titanium:			
Rutile ore and concentrate	552	573	Australia 572.
Oxide and hydroxide	3,219	1,363	Australia 590; Japan 270; United States 170.
Tungsten metal including alloys, all forms	4	3	Australia 1; Netherlands 1.
Zinc:			
Ore and concentrate	15	--	
Oxide and peroxide	1,331	352	Taiwan 148; Australia 114.
Metal including alloys:			
Scrap	25	21	All from Japan.
Unwrought and semimanufactures	13,410	9,512	Japan 5,380; Australia 2,644.

See footnotes at end of table.

Table 3.—Philippines: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Other:			
Ores and concentrates of base metals, n.e.s	323	32	Japan 26; Australia 6.
Oxides, hydroxides and peroxides of metals, n.e.s	118	188	United States 84; Japan 70.
Metalloids	--	2	Mainly from Japan.
Nonferrous base metals including alloys, all forms, n.e.s	13	67	Canada 30; United States 8.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	407	622	Greece 374; United States 117; Italy 80.
Dust and powder of precious and semi-precious stones—kilograms	25	1,120	Japan 700; Congo 420.
Grinding and polishing wheels and stones	774	822	Taiwan 172; United Kingdom 134; Japan 114.
Asbestos	4,090	1,899	Canada 1,324; Italy 245; United States 207.
Barite and witherite	1,617	2,060	United States 1,003; Singapore 937.
Boron materials, oxide and acid	587	384	United States 330; Spain 25.
Cement	r 9,267	14,580	Japan 13,028.
Chalk	5	200	Japan 190.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Bentonite and fuller's earth	5,239	1,045	United States 808; Japan 237.
Fire clay	572	723	United States 395; Japan 196; France 56.
China clay	8,545	4,686	United States 1,494; Japan 1,201.
Other	17,971	7,726	United States 4,962; Japan 1,847.
Products:			
Refractory (including nonclay bricks) value, thousands	$6,852	$7,765	Japan $2,698; United Kingdom $1,930.
Nonrefractory —do	$149	$376	Japan $168; Republic of Korea $114.
Diamond, industrial —carats	85,580	82,020	Congo 79,420; Ghana 2,600.
Diatomite and other infusorial earth	1,974	1,306	Japan 380; Republic of Korea 150.
Feldspar and fluorspar	4,456	2,649	Thailand 776; India 571; Japan 339.
Fertilizer materials:			
Crude, phosphatic	116,756	174,403	United States 156,102; Australia 17,801.
Manufactured:			
Nitrogenous	244,464	87,998	United States 27,719; Japan 21,930; Italy 12,000.
Phosphatic	187,474	13,990	United States 10,000; Israel 2,498.
Potassic	r 89,466	90,368	Canada 49,338; United States 33,505.
Other including mixed	r 194,477	48,746	Yugoslavia 14,300; France 10,007; United Kingdom 8,416.
Ammonia	135,900	116,651	Japan 106,715.
Graphite, natural	160	168	Sri Lanka 40; Republic of Korea 34; West Germany 32.
Gypsum and plasters:			
Gypsum	6,962	24,149	Japan 21,211; Thailand 2,878.
Plasters	3,705	4,093	West Germany 3,757.
Lime	499	691	United States 489; West Germany 150.
Magnesite	2,852	879	Austria 320; Japan 275; United Kingdom 170.
Mica:			
Crude, including splittings and waste	50	81	India 30; United States 28.
Worked, including agglomerated splittings	8	11	United States 5; India 2; Japan 2.
Pigments, mineral:			
Natural, crude	2,406	2,433	United Kingdom 1,523; India 824.
Iron oxides, processed	1,061	1,191	India 522; West Germany 372; Spain 122.
Precious and semiprecious stones, natural, except diamond —carats	7,500	--	

See footnotes at end of table.

Table 3.—Philippines: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Salt	45,448	46,263	Australia 27,090; India 18,432.
Sodium carbonate, natural and manufactured	91,399	46,217	United States 21,035; Japan 12,101; Kenya 7,697.
Sodium compounds, caustic soda	16,811	12,705	United States 4,524; Japan 4,033; Australia 1,278.
Stone, sand and gravel:			
Dimension stone, crude and worked	102	104	People's Republic of China 62; Japan 20.
Dolomite	8,363	8,812	Japan 7,637.
Gravel and crushed stone	479	80	Mainly from France.
Limestone (except dimension)	539	675	All from Japan.
Quartz and quartzite	236	151	France 55; United Kingdom 35; Netherlands 23.
Sand:			
Silica	6,121	7,300	Australia 6,800.
Other	335	42	United States 29; Japan 10.
Stone for industrial uses (including soapstone), n.e.s	271	189	France 100; Japan 82.
Sulfur:			
Elemental, all forms	34,912	25,925	Iran 21,967; Canada 3,287.
Sulfur dioxide	3	13	Mainly from West Germany.
Sulfuric acid	36	30,002	Japan 29,981.
Talc	5,918	3,546	Republic of Korea 2,677; United States 353.
Other nonmetals, n.e.s.:			
Crude	1,579	172	Australia 100; Japan 50.
Oxides and hydroxides of magnesium, strontium, barium	543	536	Australia 287; United States 155; United Kingdom 77.
Bromine, iodine, fluorine	1	5	United States 3; France 2.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	389	788	Republic of Korea 450; United States 338.
Carbon black	887	268	United States 125; Japan 83.
Coal, coke, briquets	26,634	15,656	Japan 14,785.
Hydrogen and other rare gases	204	102	Japan 94.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	62,275	67,176	Saudi Arabia 35,272; Kuwait 13,501; Indonesia 5,132.
Refinery products:			
Gasoline:			
Aviation ---do---	226	358	Iran 244; Japan 112.
Motor ---do---	255	(1)	All from United States.
Kerosine and jet fuel ---do---	(1)	(1)	Do.
Distillate fuel oil ---do---	3,755	1,994	All from Bahrain.
Lubricants ---do---	886	475	United States 200; Japan 169.
Other:			
Liquefied petroleum gas ---do---	96	155	Singapore 67; Indonesia 63; Australia 15.
Naphtha ---do---	1,314	1,560	Singapore 863; Bahrain 447.
Mineral jelly and wax ---do---	96	61	Indonesia 28; People's Republic of China 9.
Unspecified ---do---	50	19	Netherlands Antilles 11; United Kingdom 2.
Total ---do---	6,678	4,622	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	607	1,441	Japan 800; Australia 508.

r Revised.
1 Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—To meet the increasing demand for aluminum, which had been primarily met by imports of several tens of thousand tons of the metal annually, Philippine planners have been looking into producing aluminum locally. One of the schemes suggested by an international consortium was to establish alumina facilities in Mindanao (and later aluminum reduction facilities), based upon bauxite imported from Weipa in Australia. This proposed project envisages very large tonnages for international markets, with a small spillover for Philippine consumption. Late in 1976, there were rumors that the venture might instead be sited in Australia. Earlier, Reynolds International Inc. was considering building a 100,000-ton reduction plant in Leyte, but this was also indefinite, since Reynolds subsequently relinquished 60% of its equity to the Government. Reynolds produces aluminum products in the Philippines. Comalco Ltd.'s $11 million cold-rolling mill at Cainta, Rizal, near Manila was on schedule, with startup planned for March 1978 for the production of about 6,000 tons of aluminum sheet and foil annually.

Chromite.—Eleven chromite producers (mostly on Luzon but some in Mindanao and elsewhere) were in operation during 1976, compared with only five in 1975. The Government had encouraged chromite mining in the form of tax incentives and other benefits. However, overall production was down from about 520,000 tons in 1975 to about 427,700 tons in 1976. Consolidated Mines Inc., by far the largest Philippine refractory chromite producer, shipped only 304,200 tons compared with 420,300 tons in 1975 and 484,600 tons in 1973. This was because Typhoon Didang caused serious damage to the mine at Coto, Zambales, and the road leading to the port as well. Total ore reserves at Coto were estimated at 6.3 million tons in 1976. It was too early to judge the potential performance of the new chromite producers like Velore Mining Corp., New Frontier Mines, Silveria Eleazar, and Misamis Exploration Corp., which together produced only about 17,000 tons in 1976. Output of Acoje Mining Co. Inc., with about 1.73 million tons of 22% metallurgical chromite reserves in Zambales, declined from 97,000 tons in 1975 to 84,800 tons in 1976. This was just about made up by the 13,700 tons produced by the newcomer, G. Lluch & Sons, Inc. Acoje Mining and G. Lluch were the only important Philippine metallurgical chromite producers during 1976. Nonchrome refractories were cutting into the market for Philippine refractory chrome and it has always been difficult to sell fines. On the other hand, demand for the country's metallurgical chrome should continue to be brisk.

Copper.—Copper, the major mineral product of the Philippines, recovered from the decline in prices that started in late 1974. The average copper price increased to 61 cents per pound in 1976, from 53 cents in 1975. Thus, despite an output increase of only 5.5%, total value increased 16.4%. The resumption of Lepanto Consolidated's operations during the latter part of 1976 plus the expansion effected by other mines further improved the copper picture. In fact, most of the 14 companies with 15 mines were in the process of expanding mine-plant capacity, with overall prospects of raising Philippine copper production about 20% by yearend 1977, to roughly 300,000 tons per year. The Philippine Bureau of Mines further projected in 1976 that the country's copper output might again double in a decade. According to data in late 1976, individual company expansion programs for production were as follows, in tons per day of ore:[4]

[4] Engineering and Mining Journal (New York). June 1977, pp. 233–234.

Company	Production		Completion date
	1976	Target	
Atlas Consolidated	65,000	100,000	Yearend 1977
Marcopper Mining	16,500	27,000	Yearend 1977
Philex Mining	21,000	28,000	Yearend 1978
Marinduque Mining (Sipalay)	14,000	18,000	Yearend 1977
Western Minolco Corp	15,000	30,000	Before 1980
Consolidated Mines	1,500	15,000	Yearend 1977
Baguio Gold Mining Co	3,500	8,000	Yearend 1977
Acoje Mining	500	1,000	Yearend 1977
CDCP Mining Corp	--	10,000	Yearend 1979
Sabena Mining Corp	--	10,000	1978 or 1979
Benguet Consolidated	--	12,000–27,000	1979 or 1980

Atlas Consolidated was again the largest Philippine copper producer, producing from two open pits (Frank and Biga) and one underground block-caving mine called Lutopan on Cebu Island. Atlas mined about 22 million tons of 0.51% copper ore during 1976, together with 70 million tons of waste. The new Carman pit and 32,000-ton-per-day flotation mill costing nearly $100 million were about 40% completed at yearend, and expected to come onstream in the fall of 1977. Marcopper Mining raised output at its Marinduque operations by one-third and strengthened its hold as the country's No. 2 copper producer by partially expanding its 16,500-ton-per-day mill about 50%. Marcopper beneficiated about 8.8 million tons of 0.59% copper ore during 1976, and successfully drilled through its "San Antonio" tailing pond to delineate additional reserves. Marinduque Mining produced just over 32,600 tons of mine copper (mainly from Sipalay in the Negros) in 1976, a slight decline from a year earlier. Marinduque plans eventually to triple Sipalay's mill capacity to 50,000 tons per day of ore. Philex Mining raised output of its Baguio block-caving properties only slightly. Its ore is only 0.4% copper but it is high in gold values. Production of mine copper in the Philippines, by individual producer, was as follows, in tons:

Company	1976
Acoje Mining	1,757
Apex Exploration & Mining Co., Inc	2
Atlas Consolidated	102,439
Baguio Gold Mining	4,380
Benguet Consolidated	1,521
Benguet Exploration Inc	45
Black Mountain Inc	3,379
Itogon-Suyoc Mines Inc	18
Lepanto Consolidated	4,197
Marcopper Mining	47,534
Marinduque Mining:	
Bagacay project	5,428
Sipalay project	27,216
Philex Mining	30,447
Western Minolco	8,949
Zambales Base Metals Inc	276
Other	558
Total	238,146

Philippine copper concentrates are all exported, predominantly to Japan. In 1975, 762,428 tons of copper concentrates were exported, including 648,060 tons to Japan, 43,180 tons to the United States, and 28,194 tons to the People's Republic of China. Atlas Consolidated's output went mainly to Mitsubishi Metal Corp. in Japan, Marcopper sold mainly to North America, Marinduque Mining shipped to Mitsui & Co., Ltd.'s smelters in Japan, Philex Mining exported to its Japanese affiliate Nippon Mining Co., Ltd., and Lepanto Consolidated traditionally sold its copper-gold concentrates to the Takoma smelter in Washington where the pollution problem has become an obstacle. Sale of copper concentrates to China is a recent development. The latest agreement with China calls for delivery of 40,000 to 60,000 tons of copper concentrates.

The country's first copper smelting project started to take shape in late 1976 under the Philippine Associated Smelting and Refining Corp. formed by the five leading companies and the Philippine Government. The 84,000-ton, $250 million Outokumpu Flash smelter and refining complex, to be built at Bantiqui Point, San Juan, Batangas, Luzon, was being engineered by Arthur G. McKee & Co. The target startup date for this smelter was late 1977. The Philippines had need for such a smelter in view of the growing market for copper. However, even with this project, most of the country's concentrate production would have to be exported.

Gold.—Production of gold held steady at just over 500,000 troy ounces per year. Benguet Consolidated, the foremost primary gold producer, put out only half the 1973 level. Depleting reserves and spiralling operating costs had taken its toll on Philippine gold producers. For 1976, average gold prices stood at about $125 per troy ounce, whereas unit production costs were $5 to $15 higher. Lepanto Consolidated was the second company primar-

ily responsible for the bad performance in 1976; its mine near Baguio was shut down most of the year, because foreign copper smelters shunned the use of Lepanto's high-gold-content enargite which releases arsenic in smelting. The byproduct gold producers (from copper) headed by Philex Mining, Atlas Consolidated, and Marcopper Mining, more than held their own. Philex Mining has been the country's leading gold producer for the last 2 years. Output records for the largest gold producers in the Philippines are as follows, in troy ounces:

Company	1975
Atlas Consolidated	79,700
Baguio Gold Mining	4,900
Benguet Consolidated	127,400
Benguet Exploration	13,300
Itogon-Suyoc Mines	28,600
Lepanto Consolidated	40,500
Marcopper Mining	31,800
Philex Mining	134,400
Western Minolco	19,400
Other	21,800
Total	501,800

To alleviate the serious financial difficulties of the gold industry, the Philippine Government extended a subsidy to primary gold producers through Presidential Decree 1070, in addition to loans. The amount of help was fixed at 70% of the difference between the cost of production per troy ounce (excluding depreciation, amortization, and headquarter overhead expenses) and the selling price. Following the improvement of gold prices near yearend, however, several primary gold producers partially liquidated their gold inventory and paid back the loans received under the Central Bank Gold Financing Assistance Plan.

By yearend 1976, the new gold refinery and mint of the Philippine Central Bank were nearly completed, with startup date scheduled for the second quarter of 1977. Capacity will be 600,000 troy ounces of gold and 450,000 troy ounces of silver per year.[5] The plant was to have provisions for future expansion to refine byproduct gold as soon as a copper smelter was built in the Philippines.

Iron Ore.—Philippine mining of iron ore, consisting totally of beach sand operations after the closure of Philippine Iron Mines Inc.'s facilities in 1974, came to a standstill in the second half of 1976. Filmag (Philippines) Inc. and Inco Mining Corp. were the last remaining operators working on titaniferous magnetite sands for sale to Japan. Philippine iron sand output for 1976 as a whole was not much more than 500,000 tons and only 42% of the tonnage in 1975. Apparently the closures were brought about as a result of alleged environmental damage to the beaches and dunes. In 1977, however, Filmag was permitted to resume its operations at Ilocos Sur. In late 1976, C. Itoh & Co. of Japan signed a $23 million contract with Apex Exploration & Mining Co. to import 2.25 million tons of iron sands over 8½ years starting in 1977, from the Gonzago mine on Luzon.

The country has also been producing annually about 100,000 tons of pyrite cinder. Most of the pyrite was produced by the copper companies, headed by Atlas Consolidated.

A 5-million-ton-per-year sinter plant of the Philippine Sinter Corp., a subsidiary of Kawasaki Steel Corp. of Japan, was scheduled to become operational by April 1977. This $230 million plant being built in Misamis Oriental, Mindanao, was scheduled to use iron ore imported from Brazil and Australia and local limestone (approximately 900,000 tons yearly).[6]

Iron and Steel.—A proposed direct reduction project for the Philippines was indefinitely shelved in mid-1976, because of high oil prices. Instead, a conventional integrated steel plant was decided upon, was scheduled for completion by 1981. The key is the blast furnace plant to supply pig iron for making 1.25 million tons per year of steel products initially. This would be located near the Kawasaki iron ore sintering plant in Northern Mindanao that in turn is 80 kilometers east of National Steel Corp.'s electric smelting and rolling plant at Iligan. Most of the raw materials for the proposed steel works will have to be imported.

The Philippines now consumes nearly 1.5 million tons of various steel products annually, which are mostly imported from Japan. Elizalde Steel Consolidated and National Steel are the main producers of

[5] World Mining (San Francisco). Catalog, Survey & Directory Number 1977. June 25, 1977, pp. 141–142.

[6] Mining Journal (London). Mining Annual Review 1977. June 1977, p. 426.

steel products. Elizalde took over National Steel's tin plant lines in 1976, and produces about 100,000 tons per year of tin plate from facilities concentrated at the Rizal works.

Nickel.—Production at the Surigao nickel refinery of Marinduque Mining was increased from 28% of designed capacity in 1975 to 45% in 1976 or about 15,000 tons of contained nickel. Two major shutdowns prevented the realization of 1976 production targets. The highest monthly output rate was attained in June 1976—62% of designed capacity. This Sherritt-Gordon process plant was still not able to totally solve its startup technical problems because of the high-moisture and low-grade nature of the ores. The mine on nearby Nonoc Island delivered 2.8 million wet tons (1.8 million dry) of ore to the refinery, analyzing 1.2% nickel, 0.12% cobalt, and 45% iron. A second project on Palawan by Atlas Consolidated, to use the Freeport ammonia-leach process, was postponed indefinitely. However, a third project under Rio Tuba Nickel Mining Corp. was preparing to ship sizable quantities of 2.4% nickel ore to Japanese firms from its operation on Palawan.

Other Metals.—Benguet Exploration Inc. produced all of the country's mine zinc from a mine in Baguio, with output in 1976 at 11,410 tons which was 9% higher than in 1975. In value this company produced as much in precious metals as it did in zinc. The Philippines also produced 4,580 tons of mine lead. Silver production declined another 6.6% in 1976. Derived as a byproduct of copper and gold, and of minor importance, the value of silver produced during the year was equivalent to only 3% that of copper and 6% that of gold. Philippine production of mercury ceased in 1976 and production of manganese ore was resumed.

NONMETALS

Cement.—The Philippine cement industry was close to 5 million tons per year in capacity and $120 million in annual gross sales. There were about 15 cement producers in 1976, headed by Island Cement Co., Northern Cement Co., Republic Cement Co., and Bacnotan Construction Industrial Corp. A massive road-building program has been underway and there has been much construction in metropolitan areas. Small quantities of cement have also found their way into the international markets.

Perlite.—Construction of a perlite plant in Legaspi City, Albany, northwestern Philippines, began during 1976.[7] Scheduled to start operations by mid-1977, this plant will be the first of its kind in the country. It is 60% Philippine and 40% U.S. owned, and managed by Grefco International. The most important use in the Philippines was filtering, but perlite is also consumed in sugar refining, food processing, nickel extraction, beer brewing, oil processing, lightweight aggregates, horticulture, and cryogenic insulation. Philippine perlite ore has already been exported in large volumes to Taiwan, Thailand, Singapore, and Australia.

Other Nonmetals.—Approximately 6.8 million tons of limestone was produced in 1976, predominantly for cement manufacture. The gypsum needed for making cement and plaster came from indigenous natural ores and more importantly, as a by-product of the phosphate fertilizer industry. The phosphate rock consumed in making chemical phosphates came entirely from the United States. Pyrite production (byproduct of copper mining) amounted to less than 200,000 tons in 1976. Annual clay output approached the 500,000-ton level. A 45,000-ton bentonite mine and drying plant, built as a joint venture of Lepanto Exploration (Asia) Inc. and Filmag (Philippines) Inc., was recently brought into production. Adequate lime was produced to meet demand. Yearly salt output has been in the 200,000-ton range in recent years, nearly adequate to meet demand.

MINERAL FUELS

Coal.—Philippine coal production and consumption remained at nominal levels. The long-range plan to develop a sizable steel industry had been based upon imports of good quality coal. Late in 1976, however, Philippine Government engineers confirmed the discovery of a workable "high-grade" coal deposit in the Naga-Uling region of Cebu, with initial recoverable reserves of 3.6 million tons.[8] Plans

[7] Asia Mining (Manila). March 1977, p. 19.
[8] World Coal (San Francisco). August 1977, p. 8.

have been made to start production by 1979.

Petroleum.—Exploration continued on a moderate scale during 1976. The Government requires the State-run Philippine National Oil Co. (PNOC) to be a partner in every search venture through converting all exploration concessions to Indonesian-style, production-sharing contracts. A presidential decree directed all operators (about 50 firms) to convert to contracts or lose exploration rights by August 26, 1976. In the event of commercial production and with oil companies taking all the risk, costs would be recovered from its first 40% of production. The remaining 60% was split 60–40 (later 65–35) in favor of PNOC. Much speculation has taken place in the stock market with no significant oil discoveries as yet. Offshore Palawan seems the most promising, especially in the light of a second discovery by Cities Service International Inc. in early 1977. Because of the fractured nature of Philippine geology, however, undue optimism did not appear warranted.

Meanwhile, all oil consumed by the Philippines continued to be imported. Crude oil imports have been close to 10 million tons annually, and refined petroleum imports over 500,000 tons. Three oil refineries [9] have a combined capacity of about 247,000 barrels per day or roughly 12.3 million tons per annum. The National Iranian Oil Co. was involved in the construction of a new 60,000-barrel-per-day refinery for the Philippines, location unknown. The country imported $943 million worth of oil in 1976, predominantly from the Middle East. Lately, however, important quantities were being purchased from China.

[9] Bataan Refining Corp.'s 108,000-barrel-per-day refinery at Limay, Caltex (Philippines) Inc.'s 71,000-barrel-per-day refinery at Batangas, and Shell Philippines Inc.'s 68,000-barrel-per-day refinery at Batangas.

The Mineral Industry of Poland

By Tatiana Karpinsky [1]

In 1976, Poland continued to hold 10th place in total world industrial output and fourth place (after the United States, the U.S.S.R., and the People's Republic of China) in the world production of bituminous coal. Poland had a significant share of world output of copper (3.6%), crude steel (2.3%), sulfuric acid (3.5%), and cement (2.7%). Capital investment in the economy in 1976 totaled 577 billion zlotys (Zl),[2] an increase of 19.2% over that of 1975.[3] The investment of industry totaled Zl278 billion, an increase of 16.2% over that of 1975.[4]

According to Polish sources, the national income of Poland in 1976 increased 7.5%, and industrial production increased about 10.7%.[5] The total value of gross industrial production in 1976 amounted to Zl2,096.8 billion.

Among branches of industry, the electrical and manufacturing industries were the most important. In 1976, they contributed 28.2% to Poland's total industrial output. The fuel industry contributed 12%, the metallurgical industry 11.5%, the chemical industry 9.9%, and the mineral industry 3.7%.[6]

Major projects put into operation in 1976 included the first stage of the Katowice foundry, the steel rolling mill at the Lenin foundry, two energy blocks at the Dolna Odra powerplant, and the addition of a second lane to the Warsaw-Katowice Highway. "The Chemical Factory Police II" project also started in 1976.

In 1976, employment in the mining industry accounted for 9.6% of the total national labor force. Of the 338,100 employees in the coal industry, a total of 220,600 were working in underground mines. Employment in steelmills accounted for 170,200 workers. There were 65 hard coal mines and 27 ironworks in operation in 1976.

Government Policies and Programs.—Poland's economy is centrally planned and controlled by the Government. The final targets for the 1977 annual plan were approved by the Seventh Congress of the Polish United Workers' Party and ratified by the Seym in December 1976. The plan places special emphasis on modernizing and expanding existing plant facilities, increasing labor productivity, improving the organization of production processes, and further increasing wages and real income.

The 1977 annual plan foresees an increase in national income of 5.7%. The plan calls for a 7.3% increase in gross industrial output with a 6% growth in the fuel industry, 5.7% in the metallurgical industry, 8.6% in the electrical equipment industry, 7.2% in the chemical industry, and 9.1% in the mineral industry.[7]

The planned increases in commodity production for 1977, in million tons unless otherwise specified, are as follows:

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[1] Foreign mineral specialist, International Data and Analysis.

[2] Depending upon the purpose of the exchange, the value of the Polish zloty (Zl) may vary considerably. Where necessary, values have been converted from zlotys to U.S. dollars at the official exchange rates of Zl3.32 = US$1.00 (basic rate) and Zl19.92 = US$1.00 (special commercial rate).

[3] Biuletyn Statystyczny (Statistical Bulletin), Warsaw. February 1977, p. 13.

[4] Work cited in footnote 3.

[5] Trybuna Ludu, Warsaw. Jan. 27, 1977.

[6] Page 14 of work cited in footnote 3.

[7] Manitor Polski (Polish Monitor). Dec. 27, 1976, pp. 445-453.

	Planned 1977 production	Percent increase over 1976
Copper	0.320	19.9
Iron and steel:		
Crude steel	18.2	16.7
Rolled products	12.2	6.1
Fertilizer materials:		
Nitrogen	1.7	13.3
Phosphorus	.9	--
Bituminous coal	186.0	3.7
Electrical energy billion kilowatt-hours	112.0	7.6
Natural gas billion cubic meters	7.6	13.4

In 1977, the U.S.S.R. will continue to supply primary commodities and materials of foremost importance to the Polish economy, including crude oil and petroleum products, natural gas, iron ore, potassium salts, and cement. Poland will supply the U.S.S.R. with coal, sulfur, chemical raw materials, and other materials.[8]

PRODUCTION

The 1976 plan for production of many mineral commodities was met, but output of chemical fertilizers, cement, building materials, and rolled steel products failed to meet the goals of the annual plan.[9]

Poland continued to develop its mining industry as part of the plan to expand its industrial base. The following production increases were reported for 1976 (in percent): Hard coal, 4.5; electric energy, 7.1; steel, 4.2; electrolytic copper, 8.6; and cement, 7.0.

The increase in production of bituminous coal in 1976 was 7.7 million tons, but brown coal production decreased 0.6 million tons in the same period.

The largest new investment project in the coal industry in 1976 was the development of the Lublin coal basin with the first output of coal planned for 1978. Development also began on the 40-million-ton-per-year-capacity surface mining operation in the Belchatow region. Modernization and development of mines in the Upper Silesia coal basin continued; the Swierklany mine with a capacity of 8,000 tons per day was underway. The first extraction of coal from this mine was expected in December 1979. Another mine was under development near Swierklany with a planned capacity of 12,000 tons per day. Coal output was increased not only by developing new mines and renovating existing ones, but also by improving labor organization.

In 1976, production of iron ore decreased 518,000 tons from that of 1975 and remained below the country's requirements. An additional 15.8 million tons was imported during the year. Crude steel production in 1976 reached 15.6 million tons, compared with 15.0 million tons in 1975.

In December 1976, the first stage of the Katowice steelworks was commissioned. After completion of the first stage in 1977, production is to increase to 4.5 million tons of crude steel per year. Poland's plan in the steel industry is to decrease use of the Martin process in steel production and increase use of the oxygen converter process. The usage of the oxygen converter process in production of steel increased from 12.8% in 1970 to 22.5% in 1975 and is planned to reach 45% in 1980.

In the nonferrous industry, Poland continued to develop its rich copper deposits in the Legnica Glogow region with loans from Western banks and to produce electrolytic copper and copper products instead of copper concentrates.[10] In 1976, production of electrolytic copper amounted to 270,100 tons, an increase of 21,500 tons over the 1975 level.[11] To develop the copper industry, Zl40 billion was invested during the past 15 years (until 1975). In the next 15 years, the sum required will reach Zl350 billion.[12]

In every branch of the nonferrous metallurgy industry, investments were in progress. In 1976, Poland produced 237,000 tons of zinc, 80,600 tons of lead, and 103,000 tons of aluminum.

Among nonmetallic minerals, sulfur production reached 4.89 million tons, 120,000 tons over that of 1975. About 60% of the

[8] Polish Foreign Trade, Warsaw. March 1977, p. 40.
[9] Work cited in footnote 7.
[10] East-West Markets. Feb. 21, 1977.
[11] Central Statistical Office of the Polish People's Republic. Maly Rocznik Statystyczny (Concise Statistical Yearbook), Warsaw, 1977, p. 102.
[12] Zycie Warszawy (Warsaw Life), Warsaw. No. 2-3, August 1975.

output came from the largest mine, Jeziorko, located in the Tarnobrzeg Basin. Total production of salt in 1976 amounted to 3.8 million tons, an increase of 6.9% over that of 1975. Mining of rock salt continued in the Klodawa and Inowroclaw regions and in the Carpathian foothills (Bochnia and Wieliczka).

Production of crude petroleum decreased from 553,000 tons in 1975 to 455,000 tons in 1976. About 15.1 million tons of crude oil was imported. Because supplies of Soviet oil were limited, Poland was also importing oil from the Middle East and northern Africa.

Output of gas was 6.7 billion cubic meters in 1976, an increase of 736 million cubic meters over that of 1975. In addition, 2.5 billion cubic meters was imported from the U.S.S.R.

Under the 1976–80 plan, both the quantity and the range of industrial output are to be expanded significantly. The plan foresees that in 1980 Poland will produce about 207 million tons of coal, 22.2 million tons of crude steel, 430,000 tons of copper, 150 million pieces of roller bearings, 135 billion kilowatt-hours of electric energy, and 26.6 million tons of cement.[13] Development of production of aluminum and other nonferrous metals is expected according to the plan.

[13] Polish Foreign Trade, Special Issue, Warsaw. 1977, p. 2.

Table 1.—Poland: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum metal, primary ---tons	102,000	103,000	103,000
Cadmium metal, primary [e] ---do	350	[r] 370	400
Copper:			
Mine output, metal content ---do	185,000	230,000	267,000
Metal:			
Smelter ---do	185,000	230,000	270,000
Refined, including secondary ---do	194,500	248,600	270,100
Iron and steel:			
Iron ore and concentrate, gross weight	1,296	1,192	674
Pig iron	7,654	7,604	7,912
Ferroalloys:			
Blast furnace	133	148	124
Electric furnace	157	166	164
Steel:			
Crude	14,565	15,004	15,639
Semimanufactures:			
Rolled, excluding pipe	10,558	11,085	11,501
Pipe	1,101	1,146	1,135
Lead:			
Mine output, metal content [e] ---tons	[r] 70,000	[r] 74,600	74,700
Metal, refined, including secondary ---do	71,600	76,200	80,600
Nickel, mine output, metal content [e] ---do	2,000	[r] 2,000	2,800
Silver, mine output, metal content [e] ---thousand troy ounces	5,800	7,400	8,000
Zinc:			
Mine output, metal content [e] ---tons	200,000	[r] 210,000	180,000
Metal, refined, including secondary ---do	233,000	243,000	237,000
NONMETALS			
Barite ---do	51,500	53,500	80,342
Cement, hydraulic	16,765	18,500	19,800
Clays and clay products:			
Crude:			
Bentonite [e]	50	50	50
Fire clay	1,303	1,380	1,261
Kaolin	86	84	95
Products	820	827	794
Feldspar [e]	30	30	30
Fertilizer materials, manufactured:			
Nitrogenous:			
Gross weight	4,113	4,244	4,225
Content [2]	1,457	1,533	1,548
Phosphatic:			
Gross weight	2,737	2,883	2,842
P_2O_5 content [2]	823	929	928
Gypsum and anhydrite, crude [e 3]	[r] 1,110	[r] 1,200	1,250
Lime (quicklime and hydrated lime)	7,958	8,247	8,117
Magnesite, crude ---tons	23,800	26,800	25,600
Salt:			
Rock	1,405	1,582	1,652
Other	1,890	1,942	2,116

See footnotes at end of table.

Table 1.—Poland: Production of mineral commodities—Continued

(Thousand metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
NONMETALS—Continued			
Sodium and potassium compounds, n.e.s.:			
Soda ash	[r] 714	715	726
Caustic soda	361	392	388
Stone, sand and gravel:			
Stone:			
Dolomite	2,221	2,341	2,393
Limestone	8,400	7,600	7,300
Marlstone	78	85	--
Quartzite	163	252	265
Other	13,950	15,937	16,319
Sand (for molding)	503	603	NA
Sulfur:			
Native:			
Frasch [e]	[r] 3,658	[r] 4,321	4,341
Other than Frasch [e]	[r] 435	[r] 450	550
Total	4,093	4,771	4,891
Byproduct:			
From metallurgy [e]	[r] 227	[r] 230	235
From petroleum [e]	[r] 23	[r] 25	25
Total	[r] 250	255	260
From gypsum [e]	53	55	55
Total sulfur	4,396	5,081	5,206
MINERAL FUELS AND RELATED MATERIALS			
Coal:			
Bituminous	162,004	171,626	179,302
Lignite and brown	39,825	39,865	39,309
Total	201,829	211,491	218,611
Coke:			
Coke oven	16,973	17,294	17,935
Gashouse	1,127	1,006	865
Total	18,100	18,300	18,800
Fuel briquets, all grades	1,789	1,860	1,673
Gas:			
Manufactured:			
Town gas—million cubic feet	23,590	20,977	18,964
Coke oven gas—do.	233,499	238,126	247,590
Natural, marketed—do.	202,670	210,580	236,572
Natural gas liquids—thousand 42-gallon barrels	436	343	[e] 400
Peat:			
Fuel—tons	4,500	3,300	2,000
Agricultural [e]—do.	[r] 35,000	[r] 35,000	35,000
Petroleum:			
Crude:			
As reported	550	553	455
Converted—thousand 42-gallon barrels	4,080	4,103	3,376
Refinery products:			
Gasoline—do.	17,578	20,290	NA
Kerosine (presumably including jet fuel)—do.	1,217	1,108	
Distillate fuel oil—do.	26,543	31,772	
Residual fuel oil—do.	21,419	26,547	
Lubricating oil—do.	2,744	2,940	
Grease—do.	100	100	
Paraffin—do.	323	323	
Liquefied petroleum gas—do.	1,392	1,659	
Bitumen—do.	6,308	6,727	
Total [4]—do.	77,624	91,466	NA

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, antimony, cobalt, germanium, gold, a variety of crude nonmetallic construction materials, and carbon black are also produced in Poland, but information is inadequate to make reliable estimates of output levels. Poland may also produce alumina in small quantities, but details on such an operation, if it exists, are not available.

[2] Includes content of multigradient fertilizers.

[3] Includes building gypsum as well as an estimate for gypsum used in production of cement.

[4] Total of listed commodities only; excludes products not reported individually in official sources, as well as refinery fuel and losses.

TRADE [14]

In 1976, Polish foreign trade turnover amounted to Zl82.7 billion, an increase of Zl6.9 billion or 9.1% over that of 1975. In 1976, total exports were valued at Zl36.6 billion, an increase of Zl2.4 billion or 7.0% over that of 1975, and the value of imports rose to Zl46.1 billion, an increase of Zl4.4 billion or 10.6% over the 1975 level. The trade balances indicated that the deficit increased 26.7% from Zl7.5 billion in 1975 to Zl9.5 billion in 1976. To redress this imbalance, the 1977 plan calls for a 13% increase in the value of exports with only a 2.7% increase in imports.[15]

In 1976, the trade balance of Poland with Council for Mutual Economic Assistance (CMEA) countries [16] showed a surplus of Zl0.2 billion, after a Zl1.2 billion surplus in 1975. The trade balance of Poland with developed market economy countries showed a deficit of Zl10.8 billion after a Zl9.8 billion deficit in 1975.

Poland's trade turnover with various country groups for 1976 is shown in the following tabulation:

Country group	Exports		Imports	
	Million zlotys	Percent	Million zlotys	Percent
CMEA and other [1] centrally planned economy countries	21,853	60	21,588	47
European Economic Community (EEC)[2]	6,724	18	12,250	27
European Free Trade Association (EFTA)[3]	2,511	7	5,225	11
Other developed countries	2,476	7	5,053	11
Developing countries	3,036	8	1,955	4
Total	36,600	100	46,071	100

[1] The People's Republic of China, Yugoslavia, Vietnam, and North Korea.
[2] Comprises the following countries: Belgium-Luxembourg, Denmark, France, West Germany, Ireland, Italy, the Netherlands, and the United Kingdom.
[3] Comprises the following countries: Austria, Iceland, Norway, Portugal, Sweden, and Switzerland.

In 1976, as in 1975, more than half of Poland's foreign trade was transacted with centrally planned economy countries of Eastern Europe. The largest turnover was achieved with the U.S.S.R. (30.3% of exports and 25.5% of imports), followed by East Germany (9.9% of exports and 7.6% of imports) and Czechoslovakia (7.8% of exports and 5.9% of imports).

Among the developed market economy countries, the largest turnover was achieved with West Germany (6.3% of exports and 8.7% of imports), followed by France (3.3% of exports and 5.8% of imports), the United States (2.6% of exports and 6.0% of imports), the United Kingdom (2.9% of exports and 4.8% of imports), and Austria (1.5% of exports and 4.2% of imports).

Among branches of the Polish industry, the most important in external trade was the electrical and manufacturing industry. In 1976, exports by the electrical and manufacturing industry contributed 44% of Poland's total exports; fuel and electric power, 18%; products of the metallurgical industry, 6%; chemical products, 2%; and products of other industries, about 30%.

The import value of manufacturing and electrical industries products accounted for 42%; products of metallurgy, 15%; chemical products, 11%; fuel and electric power, 10%; and products of other industries, about 22%.

The following were the most significant percentage increases in Poland's 1976 exports over those of 1975: 69% in petroleum products, 13% in sulfur, 8% in nitrogen fertilizers, 6% in copper, 6% in zinc and rolled zinc products, and 5% in rolled steel products. The following decreases in exports were noted: 10% in lignite and 1% in coke. The following were the most significant percentage increases in Poland's 1976 imports over those of 1975: 14% in rolled steel products, 13% in crude petroleum, 10% in pig iron, 3% in iron ore, 3% in petroleum products, and

[14] All data on 1975 Polish trade were taken from: Central Statistical Office of the Polish People's Republic. Maly Rocznik Statystyczny (Concise Statistical Yearbook), Warsaw. 1977, pp. 197–205.
[15] East-West Markets. Mar. 7, 1977, p. 3.
[16] Include the following countries: Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.

2% in natural gas. The most significant decreases in imports were 9% in zinc concentrates, 2% in potash, 2% in phosphorites and apatites, and 1% in hard coal.

In January 1977, the plenary session of the Polish-Soviet Intergovernment Commission for Economic and Scientific-Technical Cooperation met in Warsaw to set foreign trade targets for the current 1976–80 5-year period. In this period, Polish-Soviet trade exchanges are to more than double (209%) the original target of the 1971–75 period.

The degree of Poland's dependence on Soviet raw materials is further underlined by the fact that the U.S.S.R. is scheduled to deliver, in the current 5-year period, 17,000 million cubic meters of natural gas, 35 million tons of iron ore, 100% of Poland's nickel consumption, and 80% of Poland's pig iron consumption. The Polish-Soviet Commission reviewed Poland's nuclear power plans as well as the U.S.S.R.'s supply of machinery and equipment for stage 2 of the Katowice steel complex. In exchange for the imports, Poland is to provide the U.S.S.R. with 47.5 million tons of hard coal, 3 million tons of coking coal, and 3.8 million tons of sulfur.[17]

[17] Trybuna Ludu, Warsaw. Jan. 6, 1977.

Table 2.—Poland: Exports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	9,092	260	East Germany 257.
Cadmium metal including alloys, all forms	277	211	U.S.S.R. 200.
Chromium oxide and trioxide	891	1,351	United States 380; Italy 183; Norway 145.
Copper metal including alloys, unwrought and semimanufactures	r 71,560	108,179	West Germany 36,366; United Kingdom 34,321; Czechoslovakia 14,690.
Iron and steel metal:			
Scrap ---thousand tons	465	303	Liechtenstein 97; West Germany 61; Switzerland 44.
Pig iron [1]	2,657	3,757	All to Albania.
Ferroalloys [2]	508	1,239	West Germany 950; Austria 204.
Steel, primary forms, ingots	4,200	3,932	All to Hungary.
Semimanufactures, including iron and steel castings ---thousand tons	r 1,323	1,318	Romania 191; Yugoslavia 164; U.S.S.R. 153.
Lead:			
Ore and concentrate	25,522	15,263	France 6,058; Switzerland 4,142; Romania 4,102.
Metal including alloys, unwrought	8,102	40	All to Czechoslovakia.
Zinc metal including alloys, unwrought and semimanufactures	92,678	93,577	U.S.S.R. 40,380; United Kingdom 21,658.
Other nonferrous semimanufactures including alloys	r 14,189	16,537	West Germany 7,564; U.S.S.R. 3,991.
NONMETALS			
Cement	86,954	282,042	Nigeria 117,672; Sweden 66,571; Switzerland 38,681.
Clays, refractory, and burnt slate	68,367	61,771	Hungary 23,432; Italy 21,291; East Germany 7,605.
Fertilizer materials:			
Manufactured, nitrogenous thousand tons	985	905	India 274; People's Republic of China 143; East Germany 98.
Ammonia ---do	5	2	Mainly to Czechoslovakia.
Gypsum ---do	523	342	Sweden 101; Norway 81; Denmark 70.
Lime	39,915	34,345	Czechoslovakia 27,477.
Salt:			
Brine	51,691	40,765	Czechoslovakia 13,293; France 10,858; Hungary 9,022.
Rock	r 187,687	205,176	Hungary 65,821; Czechoslovakia 44,475; Sweden 40,550.
Sodium and potassium compounds, n.e.s.:			
Caustic soda ---thousand tons	7	45	U.S.S.R. 22; West Germany 6; Hungary 5.
Soda ash ---do	198	163	U.S.S.R. 72; Czechoslovakia 26.
Stone:			
Dolomite	38,094	32,062	Denmark 12.559; Czechoslovakia 10,387; West Germany 6,754.
Crushed stone	417,920	812,224	West Germany 484,934; Sweden 107,390; France 99,224.
Sulfur:			
Elemental ---thousand tons	3,024	3,080	U.S.S.R. 697; United Kingdom 366; France 330.
Sulfuric acid ---do	635	306	Czechoslovakia 129; Switzerland 64; East Germany 36.
MINERAL FUELS AND RELATED MATERIALS			
Coal and briquets:			
Bituminous ---do	40,093	38,479	U.S.S.R. 9,818; France 3,789; Denmark 3,441.
Lignite and lignite briquets ---do	5,199	3,442	East Germany 3,434.
Coke ---do	2,992	3,137	U.S.S.R. 900; East Germany 811; Hungary 296.
Peat and peat briquets	27,710	18,842	Austria 4,749; Italy 3,475; Yugoslavia 3,222.
Petroleum refinery products ---thousand tons	1,177	1,601	Sweden 509; Denmark 347; West Germany 318.

r Revised.
[1] Includes blast furnace ferroalloys.
[2] Includes electric furnace ferroalloys only.

Table 3.—Poland: Imports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	118,588	119,235	Hungary 109,978.
Oxide and hydroxide	262,566	271,588	Hungary 135,404; United States 122,097.
Metal including alloys, all forms	r 35,621	27,243	France 3,299; Yugos'avia 3,271; East Germany 3,162.
Chromium ore and concentrate	162,266	191,884	U.S.S.R. 108,163; Albania 56,038.
Copper metal including alloys, unwrought and semimanufactures	r 23,426	13,786	Sweden 4,048; Czechoslovakia 2,172; U.S.S.R. 2,166.
Iron and steel:			
Ore and concentrate ----thousand tons--	15,609	15,423	U.S.S.R. 11,106; Sweden 2,250.
Metal:			
Scrap ----------do----	211	205	Czechoslovakia 150; Bulgaria 12; East Germany 11.
Pig iron [1] ----------do----	1,662	1,798	U.S.S.R. 1,499.
Ferroalloys [2] ----------do----	14	15	U.S.S.R. 7; Norway 1.
Steel, primary forms, ingots --do----	155	488	Switzerland 100; United States 99; Romania 77.
Semimanufactures, including iron and steel castings ----------do----	r 2,399	2,132	U.S.S.R. 661; West Germany 432; Czechoslovakia 160.
Lead metal including alloys, unwrought	20,298	13,170	United Kingdom 7,876; U.S.S.R. 3,868.
Magnesium metal including alloys, all forms--	2,153	2,022	U.S.S.R. 1,733.
Manganese ore and concentrate	555,624	555,900	U.S.S.R. 479,376; France 63,544.
Mercury ----------76-pound flasks--	5,947	7,571	United Kingdom 2,321; United States 1,624; U.S.S.R. 1,334.
Tin metal including alloys, all forms	4,450	4,510	Malaysia 1,371; Bolivia 1,000; Indonesia 762.
Tungsten ore and concentrate	3,186	3,318	United Kingdom 2,289; People's Republic of China 610.
Zinc:			
Ore and concentrate	95,187	137,196	United States 59,579; Canada 25,504; Switzerland 10,283.
Metal including alloys, unwrought and semimanufactures	3,802	2,908	France 1,114; Norway 770; Yugoslavia 530.
Other nonferrous semimanufactures	r 8,837	11,387	Netherlands 5,829; Sweden 2,532; East Germany 1,069.
NONMETALS			
Asbestos	102,609	94,412	U.S.S.R. 72,670; United Kingdom 12,773.
Barite	19,271	24,442	Bulgaria 8,593; Morocco 6,848; East Germany 6,064.
Cement ----------thousand tons--	1,214	680	U.S.S.R. 596; Romania 73.
Clays, crude:			
Kaolin (china clay)	127,871	155,699	Czechoslovakia 66,369; U.S.S.R. 39,909; United Kingdom 27,836.
Refractory clays and burnt slate	24,974	36,274	U.S.S.R. 33,942.
Diatomite and other infusorial earth	r 10,522	8,891	France 3,924; United States 1,939; West Germany 1,211.
Fertilizer materials:			
Crude, phosphatic:			
Apatite concentrate --thousand tons--	741	806	All from U.S.S.R.
Phosphate rock ----------do----	2,120	2,502	Morocco 1,712; United States 393; Tunisia 282.
Manufactured:			
Potassic ----------do----	2,658	2,933	U.S.S.R. 1,797; East Germany 1,117.
Other, including mixed --------do----	57	63	Belgium 40; France 8.
Ammonia ----------do----	35	76	East Germany 54; U.S.S.R. 21.
Fluorspar	48,911	45,130	East Germany 21,068; People's Republic of China 19,472.
Graphite, natural	11,014	11,583	Austria 7,350; U.S.S.R. 3,408.
Magnesite, calcined	174,734	196,298	North Korea 90,964; Czechoslovakia 62,026.
Mica	1,390	1,763	India 1,648.
Phosphorus, white	4,517	4,473	U.S.S.R. 3,435; Czechoslovakia 676.
Soda, caustic	4,459	17,651	Romania 17,517.

See footnotes at end of table.

Table 3.—Poland: Imports of selected mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Stone:			
Dolomite	13,360	13,662	Hungary 10,053; Romania 3,057.
Quartz	1,471	2,175	West Germany 1,320; Austria 827.
Other	r 16,314	19,010	Norway 11,380; Finland 2,967; Bulgaria 1,201.
Talc	29,714	24,728	North Korea 14,417; Czechoslovakia 3,401.
MINERAL FUELS AND RELATED MATERIALS			
Coal, anthracite and bituminous thousand tons	1,233	1,132	U.S.S.R. 844; East Germany 283.
Gas, natural million cubic feet	74,761	88,639	All from U.S.S.R.
Petroleum:			
Crude thousand tons	10,582	13,306	U.S.S.R. 10,882; United Kingdom 942.
Refinery products do	3,019	3,133	U.S.S.R. 1,266; United Kingdom 514; Belgium-Luxembourg 347.

r Revised.
[1] Includes blast furnace ferroalloys.
[2] Includes electric furnace ferroalloys only.

COMMODITY REVIEW

METALS

Aluminum.—Production of aluminum totaled 103,000 tons in 1976, maintaining the same level as in 1975.

Poland imports all the alumina and bauxite required for the production of aluminum. In 1976, imports of alumina amounted to 281,000 tons, about 9,000 tons more than was imported in 1975. Imported alumina came from Yugoslavia and the United States. Bauxite was imported from Hungary and West Germany.

Production of alumina, using the Grzymek process, is expected to begin at Nowiny, near Kielce, in 1978 and reach a capacity of 100,000 tons by 1980. Primary reduction plants in the Skawina and Konin Basins are the principal aluminum production centers in Poland.

The Skawina aluminum plant, built 22 years ago with an annual capacity of 55,000 tons, is to be expanded. New potlines are to insure an 80,000-ton increase in aluminum production; half of the increase is to be accomplished during the 5-year period 1976–80 and the remainder after 1980.

Copper.—Production of copper ore totaled 19.7 million tons in 1976, an increase of 16% over that of 1975.

Five copper mines were in operation in Poland in 1976: Lublin, Polkowice, Konrad, Lena, and Rudna. Work was also started on another larger mine, the Sieroszewice, where productive capacity is estimated to be about 15 million tons of copper ore per year.

Construction and renovation of the concentrators at the three mines of the Glogow copper basin was in process. Plans were to complete those at the Lublin and Polkowice mines in June 1977 and at the Rudna mine in July 1977. The ore processing capacity of the concentrators is to increase by more than 6 million tons per year.[18]

Production of electrolytic copper was 270,100 tons in 1976, an 8.6% increase over that of 1975. It is expected that copper production will reach 320,000 tons in 1977 and about 425,000 tons by 1980.

In 1976, there were two main copper refining plants in operation: Legnica, with a capacity of 70,000 tons of electrolytic copper per year, and Glogow, with two lines of 80,000-ton-per-year capacity each. Glogow's new production unit with a capacity of 150,000 tons of copper per year

[18] Polish Foreign Trade, Warsaw. June 1976, pp. 17–23.

was reported to be under construction in 1976.[19] There is a plan to build a large foundry in Orsk on the Odra River.

In 1976, Poland exported 96,100 tons of copper, 5,800 tons more than in 1975. Exports of copper increased from 17,900 tons in 1970 to 96,100 tons in 1976. Of the CMEA countries, Czechoslovakia was the largest importer of copper from Poland in 1976. Exports of copper to Western Europe were approximately 60,000 tons in 1976, mainly to West Germany, the United Kingdom, France, and Belgium.

Under the agreement signed in December 1976 between Poland and West Germany, in exchange for a credit of 300 million Deutsche marks, Poland is to supply electrolytic copper and copper products amounting to 480,000 tons over a period of 12 years. Another agreement signed between West Germany and Poland provided for a $125 million credit over a period of 10 years to finance the development of Polish raw material resources in connection with copper mines.

Iron and Steel.—In 1976, Poland produced 674,000 tons of iron ore, a decrease of 518,000 tons or 43.5% from that of 1975.[20] The Polish steel industry is dependent upon imported iron ore. In 1976, total imports of iron ore amounted to 15.8 million tons, an increase of 407,000 tons or 2.6% over those of 1975. About 85% of this ore was imported from the U.S.S.R. and 15% from Sweden, Brazil, and East Germany.

Poland signed a contract with Sweden for the supply of 4.5 million tons of Swedish iron ore annually after 1980. Production of Poland's iron ore came mainly from the Swietokrzyskie Mountains, northeast of Krakow. Iron ore deposits in Poland are marginal, with an average metal content of approximately 30% to 35%. In 1976, production of pig iron reached 7.9 million tons, an increase of 4.1% over that of 1975. Imports of pig iron were about 2.0 million tons, an increase of 176,000 tons or 9.8% over the 1975 level.

In 1976, Poland produced 15.6 million tons of crude steel, accounting for 2.3% of world output. The 1976 production of crude steel was 4.2% above the 1975 level. In 1977, steel production in Poland is expected to reach 18.1 million tons and in 1980, about 22 million tons.

Output of rolled steel products reached 11.5 million tons in 1976, an increase of 3.8% over that of 1975. In addition, about 2 million tons of rolled products was imported, 243,000 tons more than was imported in 1975. Poland expects to produce 16.4 million tons of hot-rolled products in 1980.

The Lenin steelworks at Krakow, the largest in Poland, produced 55% of the entire pig iron output, 44.6% of the steel, 39.4% of the rolled products, 38.6% of the pipe, and 23% of the coke in 1976. Facilities at the steelworks included five blast furnaces, three oxygen converters, eight open hearth furnaces, and two tandem open hearth furnaces.[21]

A new steel rolling mill was put into operation at the Lenin plant in 1976. During the same year, the mill that was put into operation in 1975 with a projected capacity of 350,000 tons was producing thin sheet metal 0.4 to 2.2 millimeters thick. The second stage of the rolling mill was under construction and is to increase output of sheet metal more than 1 million tons per year by 1980.

At yearend 1976, the first installation for continuous steel casting was put into use at the Nawatko electric steel plant in Ostrowice. At the same time, the third 150-ton electric arc furnace was put into operation. After the project is completed, the plant is expected to produce 1.1 million tons of steel per year.[22]

In December 1976, the Katowice metallurgical plant at Losien produced its first steel. The agglomerating plant, blast and steel furnaces, and a rolling mill went into operation. Construction of a second blast furnace, a second sinter line, a third oxygen converter, and a large and a medium rolling mill for finished products are expected to be completed during 1977. The entire steelworks will then reach a capacity of 4.5 million tons of steel per year, to increase to 9 million tons after 1980.[23]

In 1976, the first blast furnace at the Katowice steelworks, with a projected capacity of 6,500 tons per day, produced 5,500 tons of pig iron per day. At the end of 1976, nearly 14,000 workers were em-

[19] Tribuna Ludu, Warsaw. Aug. 12, 1976.
[20] Work cited in footnote 11.
[21] Iron & Steel International. August 1976, p. 280.
[22] Polish Foreign Trade, Warsaw. April 1977, p. 12.
[23] Zolnierz Wolnosci (Soldier of Freedom), Warsaw. Nov. 25, 1975, p. 4.

ployed at the steelworks, including 1,100 engineers and 4,000 technicians.

Since Poland's iron and steel industry depends upon imported iron ore from the U.S.S.R., construction of a bridge is planned across the Bug River (at the border between Poland and the U.S.S.R.) for direct delivery of ore by railroad. It is expected to be completed by 1978. The new wide-gage rail line (Soviet type) is to be laid from the new bridge directly to the Katowice plant.

Lead and Zinc.—In 1976, output of zinc-lead ore amounted to 4,940,000 tons, an increase of 7.4% over that of 1975. The main production of zinc-lead ore was obtained from the Boleslaw, Olkusz, and Pomorzany mines (Boleslaw complex) and from the Orzel Bialy, Warynskiego, and Dobrowska mines (Orzel Bialy complex).

In the 2 years since the Pomorzany lead and zinc mine at Olkusz was put into operation, extraction of zinc ore has been brought to 100,000 tons per month. A rated capacity of over 2 million tons of ore per year is to be reached in 1978.

The Polish zinc industry imported 125,000 tons of zinc concentrate in 1976. Production of lead, primarily from domestic ore and scrap, is probably adequate for indigenous needs since Poland reports no imports of lead ore or concentrate.

In 1976, production of refined lead reached 80,600 tons, an increase of 5.8% over that of 1975. Production of zinc amounted to 237,000 tons, a 2.5% decrease from 1975 output. The target for 1980 calls for the production of 120,000 tons of lead and 260,000 tons of zinc. Exports of zinc metal and rolled products totaled 61,000 tons in 1976, about 30,000 tons less than was exported in 1975.

To increase production of lead and zinc, a new Imperial Smelting Furnace is planned to start operation in 1977 at the Huta Cynku Miosteczko Slaskie Works.

Prospecting on the periphery of the Upper Silesian coal basin, near old mines and on new sites, revealed rich new zinc and lead deposits in the region of Zawiercie and Tarnowskie Gory.

NONMETALS

Fertilizer Materials.—In terms of nutrient content, the Polish chemical industry produced 1.55 million tons of nitrogenous fertilizer and 0.93 million tons of phosphatic fertilizer in 1976, approximately the same level as in 1975. The goals for 1980 are to produce 2.2 million tons of nitrogenous fertilizer and 1.3 million tons of phosphatic fertilizer, and to use 250 kilograms of fertilizer per hectare of land in 1980.[24]

About 0.98 million tons of nitrogenous fertilizer was exported in 1976, an increase of 8.4% over that of 1975. The main importers were East Germany, India, Indonesia, and West Germany.

There is a shortage of phosphate ores and potash salts in Poland. In 1976, in terms of nutrient content, about 3.23 million tons of phosphorites and apatites was imported, a decrease of 2.4% from that of 1975. Potash salt imports totaled 2.86 million tons in 1976, compared with 2.93 million tons in 1975. In 1976, apatites, phosphorites, and potash fertilizers comprised approximately one-third of chemical industry imports.[25]

In 1976, the U.S.S.R. delivered about 2 million tons of potash fertilizer to Poland, with the remainder from East Germany. Apatites and phosphorites were imported mainly from the U.S.S.R. and Morocco.

Between July and December 1976, sales of fertilizer in the country dropped an average of 7%[26] and in some areas about 20% because nitrogenous fertilizer supplies decreased more than 40% at yearend. The shortage in fertilizer production was owing to a breakdown at the Wloclawek nitrogen works, one of the three main fertilizer plants. The other plants in Police and Pulawy, which depended on Wloclawek for their production of ammonia, also did not fulfill their targets.[27]

The Police I plant near Stettin, which began operation in July 1974, produced its millionth ton of complex fertilizer in 1976. To meet the domestic shortages of nitrogenous fertilizer, work began on the preparation of the site of the Police II fertilizer complex to be built with the help of the French firm, Creusot-Loire. Under the contract, Creusot-Loire is to supply equipment for two ammonia plants with an output of

[24] Trybuna Ludu, Warsaw. Mar. 22, 1977.
[25] Handel Zagraniczny, Warsaw. No. 3, 1977, pp. 17–24.
[26] Zycie Gospodarcze (Economic Life), Warsaw. Jan. 30, 1977.
[27] Slowo Powszechne (Daily Word). Mar. 18, 1977.

750 tons per day each, one urea plant with a capacity of 1,200 tons per day, and a 2,600-ton-per-day complex fertilizer plant. Completion of the plants is scheduled for 1980.[28]

Sulfur.—In 1976, Poland produced 4.9 million tons of elemental sulfur, an increase of 120,000 tons or 2.5% over that of 1975.

Exports of sulfur increased from 3.1 million tons in 1975 to 3.5 million tons in 1976. The CMEA countries, together with Yugoslavia and the People's Republic of China, purchased over 50% of Poland's sulfur exports in 1976. The chief buyers among market economy countries were Norway, Austria, Italy, Finland, and the United Kingdom.

Poland has guaranteed to supply all of the sulfur required by the CMEA countries for the near future. Poland also exports sulfuric acid. Chemadex, a Krakow-based corporation, contracted for the delivery of three sulfuric acid units, worth 56 million rubles, to the U.S.S.R. in 1977–78 as part of a total of 15 sulfur units to be built in the U.S.S.R. by 1980.

In 1976, about 89% of the total output of sulfur was extracted by the Frasch process. This method was used in two mines, Jeziorko and Grzybow. Another method, open pit mining with flotation and refining, was used in the Machow mine.[29]

Sulfur deposits southwest of Staszow and south and east of Tarnobrzeg are the principal contributors to current production.[30] In 1976, new deposits of sulfur were reportedly found near Osiek and Baranow Sandomierska. The sulfur industry is under the supervision of the Mining Union for Chemical Raw Materials, located in Krakow.

MINERAL FUELS

Coal is Poland's most important energy source, providing 94% of the nation's energy supply. In 1976, Poland's total primary energy production amounted to 204 million tons standard coal equivalent (SCE), 8.5 million tons over that of 1975, comprised of coal (93.8%), natural gas (4.4%), and crude oil (0.3%), with peat, wood, and hydropower making up the balance.

Total consumption of primary energy in Poland increased from 179.2 million tons SCE in 1975 to 188.5 million tons SCE in 1976 and is expected to reach 212 million tons SCE in 1980.

In 1976, coal was supplying about 79% of the total energy consumed in Poland, compared with 12.5% for petroleum and 6.5% for natural gas. The share of crude oil and petroleum products in total consumption of primary energy increased from 4.3% in 1960 to 12.5% in 1976 and the share of gas increased from 1.1% in 1960 to 6.5% in 1976.

The total energy balance for 1975 and 1976 is shown in table 4.

[28] Fundamenty (Fundaments). July 1976, p. 8.
[29] Sulfur. No. 122, January/February 1976, pp. 20–26.
[30] Polish Foreign Trade, Warsaw. May 1976, pp. 14–22.

Table 4.—Poland: Total primary energy balance for 1975 and 1976

(Million tons of standard coal equivalent[1])

	Total primary energy	Coal (lignite and bituminous) and coke	Crude oil and petroleum products	Natural gas	Hydropower	Other
1975:						
Production	195.2	183.6	0.8	7.9	0.3	2.6
Imports	28.8	1.1	24.4	3.3	--	--
Exports	44.8	42.3	2.5	--	--	--
Apparent consumption	179.2	142.4	22.7	11.2	.3	2.6
1976:						
Production	203.7	191.1	.6	8.9	e .3	2.8
Imports	31.6	1.1	27.1	3.4	--	--
Exports	46.8	42.7	4.1	--	--	--
Apparent consumption	188.5	149.5	23.6	12.3	e .3	2.8

e Estimate.
[1] 1 ton standard coal equivalent (SCE)=7,000,000 kilocalories. Conversion factors used are from the United Nations as follows: Hard coal, 1.0; brown coal, 0.3; coke, 0.9; crude oil, 1.47; petroleum products, 1.54; natural gas (per thousand cubic meters), 1.33; and hydroelectric power (per thousand kilowatt-hours), 0.125.

Source: Biuletyn Statystyczny (Statistical Bulletin), Warsaw. No. 2, 1977, pp. 16, 37–38.

The first nuclear powerplant in Poland is to be constructed around 1983 at the Zarnowieckie Lake in the Gdansk region with Soviet assistance. The U.S.S.R. will supply the reactor and fuel.

In 1976, electrical energy production (largely thermal) reached 104.1 billion kilowatt-hours, an increase of 7.1% over that of 1975. Installed capacity was 20,475 megawatts, an increase of 2% over that of 1975.[31] This production of electricity required 33.5 million tons of lignite and over 42 million tons of hard coal, or about 35% of Poland's annual production of coal.[32]

Coal.—In 1976, Poland produced a total of 179.3 million tons of hard coal, an increase of 7.7 million tons over that of 1975; about 15% of the bituminous coal produced represented coking coal.[33] Hard coal production is expected to reach 200 million to 210 million tons by 1980 and about 250 million tons by 1990.

Exports of bituminous coal increased from 38.5 million tons in 1975 to 39.9 million tons in 1976.[34] In 1976, the largest amount of coal was purchased by the U.S.S.R. (10 million tons), East Germany (4 million tons), and Czechoslovakia (2.3 million tons). Among market economy countries, France imported about 5 million tons; Finland, 3.3 million tons; and Italy, about 3 million tons. Japan has become an important importer of Polish coal with 820,000 tons in 1976. The United States imported 135,000 tons from Poland in 1976.

In 1976, brown coal production was 39.3 million tons, a decrease of 1.4% from that of 1975. Brown coal production is expected to reach 42 million tons in 1980 and 104 million tons in 1990.[35] Exports of brown coal amounted to 3.1 million tons in 1976. The main importers were Bulgaria, Yugoslavia, East Germany, and Romania.

Production of coke reached 18.8 million tons in 1976, of which 3.1 million tons was exported, mainly to the U.S.S.R. and East Germany. Among Western countries, the largest importers were Austria, West Germany, and Finland.

According to the Polish Central Geological Board's estimate, Poland's minable reserves in place of hard coal amounted to about 57,500 million tons on January 1, 1974,[36] of which 19,600 million tons was measured, indicated, and inferred, and 37,900 million tons was classified as undiscovered or speculative.

About 25% of the hard coal reserves represent coking coal. Of the 57,500 million tons of hard coal reserves, 55,400 million tons occurs in the Upper Silesian coal basin, about 500 million tons in the Lower Silesian coal basin, and about 1,600 million tons in the surveyed regions of the Lublin coal basin.

Poland's ultimate hard coal resources are estimated at about 70 billion tons. The surveying of these reserves is to be the object of intensive prospecting-surveying work carried out by the Geological Service of the Central Geological Board in the coming years.[37]

Brown coal reserves are estimated at 36 billion tons, of which about 15 billion tons is recognized as economically minable and 10 billion tons as probably minable.[38]

The calorific value of the Upper Silesian coals ranges from 4,800 to 7,800 kilocalories per kilogram.

The development of the coal mining industry in Poland continued in 1976. The Trzydziestoleca (30th Anniversary) mine, the latest of seven built in the Rybnik coalfield and commissioned a few years ago, increased its production to 4,000 tons of coal per day in 1976, with a projected capacity of 15,000 tons per day.

New shafts were sunk at the Jankowice mine to increase the production of coal by 1,400 tons per day. In addition, development was in progress at the Brzeszcze, Ziemovit, Andaluzja, and Halemba mines. In December 1976, the first seam of coal was reached in the newly developed Swierclany mine in the Rybnik Basin, where the first extraction level was to be at a depth of 580 meters and projected eventual depth, 835 meters. This mine, with a projected capacity of 12,000 tons per day, is expected to produce 8,000 tons of coal per day in 1979. The development of a new mine at Suszec started in 1976

[31] Zycie Gospodarcze (Economic Life), Warsaw. Apr. 17, 1977, p. 9.
[32] Zycie Warszawy (Warsaw Life), Warsaw. August 1976, pp. 1–2.
[33] Page 5 of work cited in footnote 5.
[34] Page 205 of work cited in footnote 11.
[35] Polish Coal Review, Katowice. V. 14, No. 1–3/152–154, 1976, p. 5.
[36] Polish Coal Review, Katowice. V. 14, No. 1–3/149–151, 1975, pp. 4–5.
[37] Page 10 of work cited in footnote 36.
[38] Polish Coal Review, Katowice. V. 14, No. 1–3/152–154, 1976.

and production is scheduled to begin in 1982.

Work was progressing in the new Lublin coal basin; the first two shafts of a mine near Bogdanka reached a depth of over 500 meters and were sunk by a freezing method. These shafts are to be completed at yearend 1977 and the first million tons of coal is expected to be produced in 1980. With the completion of the first stage of the project, scheduled for 1990, its annual output is to be about 25 million tons.[39] Seven mines are to be developed in the Lublin Basin in the near future.

One of the largest brown coal mining projects during the current 5-year period is at Belchatow, where surface mining operations are to provide 40 million tons of brown coal per year. The Belchatow open pit is to become operational in 1980 and is to reach target output in 1985. In 1976, a rotary excavator 200 meters long, 75 meters wide, and 7,000 tons in weight was assembled at the Belchatow lignite strip mine. This excavator is to go into operation in July 1977. The Belchatow project includes two power stations, each with a generation capacity of 4,300 megawatts.

In 1976, an agreement was reached on the construction by Krupp Industries of a major coal gasification plant at Katowice, Upper Silesia. West German bank credits totaling 2,650 million Deutsche marks will be made available, to be eventually repaid by delivery of gas from the new plant.

Natural Gas.—Production of natural gas increased from 5,963 million cubic meters in 1975 to 6,699 million cubic meters in 1976. Some 87% of the total came from the Carpathian foothills. In addition, about 200 million cubic meters of gas was obtained by draining methane from hard coal mines in the Rybnik region. Imports of natural gas from the U.S.S.R. totaled 2.5 billion cubic meters in 1976.

The limited opportunities for obtaining natural gas from domestic sources makes it necessary for Poland to increase imports. By 1980, imports are to reach approximately 4 billion cubic meters and by 1990, 11 billion to 12 billion cubic meters.

In November 1976, the two sections of the Polish-Soviet gas pipeline were joined at Kermanovice, Przemysl Province. The pipeline begins at Komarno, crosses 80 kilometers of Soviet territory to the Polish border, and then runs toward Warsaw and Gdansk. In 1979, when the pipeline is linked to the European section of the Orenburg pipeline, it will supply 2.8 billion cubic meters of gas per year.

In May 1977, Polish workers are to complete two-thirds (380 kilometers) of the Polish section of the Orenburg pipeline. About 47.6% of Poland's proved gas reserves occur in Poland's lowlands and about 44.1% in the Carpathian foothills.[40]

Petroleum.—In 1976, the output of crude oil in Poland amounted to 455,000 tons, a decrease of 17.7% from that of 1975. It is unlikely that this output will substantially increase over the next few years.

About 15.1 million tons of crude oil was imported in 1976, an increase of 1.8 million tons over that of 1975. About 12 million tons was imported from the U.S.S.R. and about 3 million tons from the Arab countries, mainly Iraq. Poland is to receive 63 million tons of crude petroleum under the revised 1976–80 Soviet-Polish trade protocol, compared with 49 million tons in 1971–75. Most of the petroleum imported from the U.S.S.R. is delivered by way of the Friendship pipeline.

In 1976, the Plock refinery, together with several smaller plants, produced a total of 15.5 million tons of refined petroleum. The plans for the petrochemical industry call for the processing of about 20 million tons of crude petroleum by Polish refineries in 1980.

Imports of petroleum products in 1976 reached 3.2 million tons, an increase of 0.1 million tons over those of 1975. Exports of petroleum products in 1976 amounted to 2.7 million tons, compared with 1.6 million tons in 1975, going mostly to the Scandinavian countries.[41] Poland's foreign trade in petroleum products for selected years is shown, in thousand tons, in the following tabulation:

	1970	1975	1976
Exports	r 1,316	1,601	2.676
Imports	r 2,424	3,133	3,216

r Revised.

[39] Polish Foreign Trade, Warsaw. March 1976.
[40] Geologiya Nefti i Gasa (Oil and Gas Geology), Moscow. No. 4, 1977, p. 60.
[41] Rynki Zagraniczne (Foreign Markets), Warsaw. No. 47, Apr. 17, 1976, pp. 2–3.

To increase processing of crude oil, construction of new facilities was accelerated at the Plock and Gdansk petrochemical complexes. In December 1976, the second cracking installation at the Plock petrochemical complex was put into operation. The installation was built with the help of U.S. and Japanese experts. It is planned to produce 750,000 tons of gasoline per year and several hundred thousand tons of intermediate products. In 1977, the Plock combine is to process 12.8 million tons of Soviet oil.

The Gdansk oil refinery was commmissioned in 1975, and in 1976 processed 1.4 million tons of crude oil. The propane and lubricating oil installations are to be put into operation in May 1977. The entire oil sections are to be completed by July 1977. In 1977, the refinery is expected to process 3 million tons of crude oil.

In 1976, construction of a refinery with a projected capacity of 3 million tons of crude oil per year was begun at the Blachownia petrochemical works in Kedzierzyn-Kozle, Opole Province. The cost of construction and equipment is estimated at Zl10 billion. The first stage of the refinery is to be completed in 1980.

Poland's recoverable reserves of crude petroleum are estimated at 6 million tons.[42] About 40% occur in Poland's lowlands, 40% in the Carpathian Mountains, and about 20% in the Carpathian foothills.[43] In 1976, intensified exploration resulted in the discovery of new crude oilfields, which did not, however, prove to be of major importance.

Plans for continued exploration for oil and gas include the drilling of 1.7 million meters of exploratory wells and 34,000 kilometers of seismic profiles during the period 1976–80. It is anticipated that 60% of the drilling will be in the Polish lowlands.[44]

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[42] United Nations. Statistical Yearbook, New York. 1976.
[43] Work cited in footnote 40.
[44] Energetyka (Energy), Warsaw. November 1976, pp. 389–391.

The Mineral Industry of Portugal

By Roman V. Sondermayer [1]

During 1976, the principal mineral materials produced in Portugal were coal, tin, tungsten, pyrite, gold, copper, iron and steel, beryl, feldspar, uranium, and cement. Output was modest by world standards except for tungsten, which amounted to about 4% of the world total.

The gross national product (GNP) was $15 billion[2] in 1976, about the same in constant prices as in 1975 although inflation was at an annual rate of 30%. The mineral industry accounted for about 5% of the GNP and employed about 49,000 persons, or 3% of the total labor force.

Following 2 years of unsettled political conditions, the Government started planning during 1976 for development of Portugal's mineral resources. A general plan for exploration and an overall inventory of mineral resources resulted, but details about spending by commodities and organizations participating in the plan were not made public at yearend.

By Decree No. 350/76 of May 14, 1976, a new Ministry of Industry and Technology (Ministerio da Industria e Technologia) was established. The new department had, among others, a secretary for energy and mines (Secretario de Estado da Energia e Minas), in charge of mining, metallurgy, and energy of the country. Three directorates (Direcçàо Geral de Minas e Metalurgia, Direcçàо Geral dos Combustíveis, and Direcçàо Geral dos Servicos Electricos) and two institutes (Instituto Portuguès de Electricidade and Instituto de Geologia Minas et Metalurgia) were the major units of the Secretariat for Energy and Mines.

A 40-hour workweek was introduced in the mining industry, and wages and fringe benefits were improved for miners, but major weaknesses in the sector (high turnover, low pay, and low productivity) remained. An interministerial commission was charged with making an economic study of the present difficulties.

PRODUCTION

Most of the activities of the mining industry were modest by European standards. Table 1 shows production statistics for 1974, 1975, and 1976.

The mining industry's enterprises were owned by both private capital and the Government. The tabulation shows major companies and principal facilities in operation in 1976.

[1] Physical scientist, International Data and Analysis.

[2] Where necessary values have been converted from Portugal Escudos (Esc) to U.S. dollars at the rate of Esc 32 = US$1.00.

Commodity	Major companies and principal facilities (with ownership)	Percent of output
Cement	Companhia Geral de Cal e Cimento S.A.R.L.—plant at Setubal	27
Coal	Empresa Mineira de Carvao de Ermesinde—mines near Oporto	70
	Companhia das Minas de S. Pedro da Cova S.A.R.L.—mines near Oporto	20
Petroleum refining	Petroleos de Portugal EP (Petrogal)—refineries at Oporto and Lisbon (Government 100%)	100
Pyrites	Piritas Alentejanas—mine at Aljustrel (Government 90%)	70
Steel, crude	Siderurgia National S.A.R.L.—works at Seixal (Government 100%)	100
Tungsten	Beralt Tin & Wolfram (Portugal) Ltd.—mine at Panasqueira (Government 45%; Charter Consolidated, United Kingdom and others)	95
Uranium	Atomic Energy Commission—mine and plant at Urgeirica (Government 100%)	100

Table 1.—Portugal: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Antimony, mine output, metal content	(1)	--	--
Arsenic, white	263	256	278
Beryl concentrate, gross weight	15	21	--
Columbite-tantalite concentrate, gross weight	9	11	5
Copper:			
Mine output, metal content:			
In cupreous pyrite	4,595	4,618	4,162
In other ore and concentrate	568	447	333
In precipitate e	5	10	10
Total	r 5,168	5,075	4,505
Metal:			
Smelter	r 3,600	3,200	e 3,200
Refined, primary	2,519	2,742	2,754
Gold, mine output, metal content, troy ounces	11,478	11,446	12,416
Iron and steel:			
Iron ore and concentrate, gross weight:			
Hematite	28,498	33,850	1,713
Magnetite	--	1,818	28,082
Manganiferous	r 24,450	20,410	17,870
Total	r 52,948	56,078	47,665
Pig iron, thousand tons	252	327	343
Ferroalloys:			
Ferrotungsten	369	303	282
Other	r 10,450	8,563	11,669
Total	r 10,819	8,866	11,951
Steel, crude, thousand tons	r 343	417	463
Steel, semimanufactures, do	329	301	336
Lead metal, refined	1,100	826	613
Manganese ore and concentrate, gross weight	r 28	--	--
Molybdenum ore and concentrate, metal content	(2)	--	--
Silver, mine output, metal content, troy ounces	23,888	24,885	26,999
Tin:			
Mine output, metal content	r 424	375	350
Metal	450	409	276
Titanium, ilmenite concentrate, gross weight	274	212	237
Tungsten, mine output, metal content	r 1,468	1,424	1,276
Uranium oxide (U_3O_8)	e 95	e 95	88
Zinc, mine output, metal content	(1)	--	--
NONMETALS			
Asbestos	180	e 200	e 200
Barite	1,489	2,429	90
Cement, hydraulic, thousand tons	3,295	3,381	3,713
Clays:			
Kaolin	r 60,724	59,355	50,516
Other	121,916	88,423	NA
Diatomite	1,933	2,090	5,501
Feldspar	29,900	16,374	10,051

See footnotes at end of table.

Table 1.—Portugal: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [p]
NONMETALS—Continued			
Fertilizer materials, manufactured:			
Nitrogenous, gross weight ---thousand tons--	586	505	656
Phosphatic, gross weight ---do---	216	226	336
Mixed and unspecified ---do---	273	290	385
Gypsum and anhydrite	143,039	149,873	159,951
Kyanite and related materials, andalusite	50	--	--
Lime (quick and hydrated) ---thousand tons--	[r] 219	215	222
Lithium minerals, lepidolite	1,200	1,200	1,110
Pyrite and pyrrhotite (including cupreous):			
Gross weight ---thousand tons--	511	462	416
Sulfur content ---do---	225	202	181
Salt:			
Rock ---do---	[r] 310	295	303
Marine ---do---	223	213	[e] 200
Total ---do---	[r] 533	508	503
Sand and gravel:			
Gravel ---do---	328	224	NA
Sand ---do---	4,497	5,537	NA
Stone:			
Calcareous:			
Dolomite ---do---	84	67	NA
Limestone, marl, calcite ---do---	8,125	6,596	NA
Marble ---do---	309	279	NA
Other:			
Basalt ---do---	32	42	NA
Diorite ---do---	3,337	6,985	NA
Gabbro ---do---	1	--	NA
Granite ---do---	4,576	4,124	NA
Graywacke ---do---	49	32	NA
Ophite ---do---	88	43	NA
Porphyry ---do---	109	121	NA
Quartz ---do---	141	101	NA
Quartzite ---do---	181	179	NA
Schist ---do---	209	168	NA
Serpentine ---do---	[r] 1	1	NA
Slate ---do---	49	43	NA
Syenite ---do---	6	5	NA
Talc	[r] 1,170	1,570	1,146
MINERAL FUELS AND RELATED MATERIALS			
Coal, anthracite ---thousand tons--	230	222	193
Coke, metallurgical ---do---	196	178	199
Fuel briquets, all grades ---do---	5	1	1
Gas, manufactured ---million cubic feet--	12,996	NA	NA
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels--	5,969	6,406	6,521
Jet fuel ---do---	1,583	2,930	2,945
Kerosine ---do---	481	524	565
Distillate ---do---	7,821	9,164	9,287
Residual fuel oil ---do---	15,614	14,441	15,416
Lubricants ---do---	726	473	518
Other:			
Liquefied petroleum gas ---do---	1,357	1,478	1,472
Asphalt ---do---	1,288	224	205
Unspecified ---do---	319	2,248	2,558
Refinery fuel and loss ---do---	1,369	3,784	3,434
Total ---do---	36,527	41,672	42,921

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] Revised to none.

[2] Less than ½ unit.

[3] Includes 14,000 tons for the Azores and 31,000 tons for Madiera Islands.

TRADE

Portugal remained a net importer of minerals; this deficit was caused mainly by the high cost of petroleum and petroleum refinery products.

Imports of minerals, valued at $0.9 billion, were 24% of the country's total imports during 1976. Exports of minerals, valued at $0.1 billion, were about 7.2% of total exports. The following tabulation shows a breakdown of Portugal's mineral foreign trade for 1975, in thousand dollars:

Commodity group	Imports	Exports
Crude nonmetals	32,548	14,532
Metal ores	14,872	15,804
Mineral fuels	588,479	39,572
Fertilizers	8,003	29,033
Cement, lime, etc	864	2,903
Ferrous metals	215,019	34,542
Nonferrous metals	64,914	3,512
Total	924,699	139,898

Table 2.—Portugal: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	1,832	1,485	Spain 1,032; West Germany 416.
Arsenic trioxide, pentoxide, and acids	283	176	Argentina 83; Uruguay 30; Australia 30; Spain 20.
Chromium oxide and hydroxide	5	(1)	NA.
Columbium and tantalum, tantalum ore and concentrate	4	11	All to United States.
Copper:			
Ore	NA	NA	
Copper sulfate	390	129	São Tomé e Principe 120.
Metal including alloys, all forms	3,075	1,669	Sweden 711; United States 398; United Kingdom 202; Norway 176.
Gold:			
Waste and sweepings ---troy ounces	44	334	All to Belgium-Luxembourg.
Metal ---do	1,000	32	All to Netherlands Antilles.
Iron and steel:			
Ore and concentrate including roasted pyrite:			
Roasted pyrite	42,997	37,681	All to West Germany.
Other	1	NA	
Metal:			
Scrap	2,501	1,719	Netherlands 1,236.
Pig iron, ferroalloys, and similar materials	10,709	47,191	United States 26,010; Italy 4,426.
Semimanufactures:			
Bars, rods, angles, shapes, sections	3,936	1,451	Cape Verde Islands 338.
Universals, plates, sheets	5,130	13,044	Romania 4,965; Switzerland 2,669; Brazil 1,743; Sweden 1,329.
Hoop and strip	1,357	757	Angola 309.
Rails and accessories	1,741	(1)	NA.
Wire	828	2,377	Morocco 1,761; Greece 499.
Tubes, pipes, fittings	5,341	5,047	Spain 1,080; France 609; Lebanon 540.
Castings and forgings, rough	2,295	3,323	United States 1,081; Sweden 673.
Lead:			
Ore and concentrates	NA	NA	
Oxides	71	7	Mozambique 3.
Metal including alloys, all forms	(1)	NA	
Magnesium metal including alloys, all forms	(1)	NA	
Manganese:			
Ore and concentrates	3,680	NA	
Oxides	(1)	NA	
Mercury ---76-pound flasks	(1)	NA	
Molybdenum ore and concentrate	4	NA	
Nickel metal including alloys, all forms	402	61	Spain 28; Netherlands 17; United Kingdom 11.
Platinum-group metals and silver:			
Waste and sweepings thousand troy ounces	NA	584	Mainly to Belgium-Luxembourg.
Metals including alloys:			
Platinum group ---troy ounces	2,842	1,412	United Kingdom 639; Spain 485.
Silver ---do	466	4,087	United States 3,444; Angola 643.
Tin metal including alloys, all forms	115	73	Netherlands 28; West Germany 8; Denmark 7.

See footnotes at end of table.

Table 2.—Portugal: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Tungsten:			
Ore and concentrate	3,195	1,940	United Kingdom 775; Netherlands 392; West Germany 326.
Metal including alloys, all forms	1	NA	
Zinc:			
Ore and concentrate	NA	(1)	NA.
Oxide	2,069	1,366	West Germany 816; Spain 211; Belgium-Luxembourg 199.
Metal including alloys, all forms	236	94	United Kingdom 89.
Other:			
Ore and concentrate:			
Of titanium, vanadium, zirconium	500	540	Italy 500.
Of base metals, not elsewhere specified	152	309	All to West Germany.
Ash and residue containing nonferrous metals	754	585	Belgium-Luxembourg 464; United Kingdom 121.
Oxides, hydroxides and peroxides of metals, n.e.s	(1)	110	France 40; Venezuela 24; Netherlands 16; Republic of South Africa 15; Argentina 15.
Base metals, including alloys, all forms, n.e.s	21	NA	
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	23	15	United States 5; Mozambique 4; Netherlands 2; Angola 2.
Grinding and polishing wheels and stones	139	NA	
Asbestos	(1)	(1)	NA.
Barite and witherite	26	234	All to Morocco.
Cement	66,610	96,739	Nigeria 68,596; Cape Verde Islands 9,900.
Chalk	119	50	Angola 21; Mozambique 18.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Kaolin	535	3	Mozambique 2; Angola 1.
Other	994	651	Spain 611.
Products:			
Refractory (including nonclay bricks)	985	684	Angola 558; Spain 98.
Nonrefractory	19,345	10,318	Spain 4,215; Cape Verde Islands 1,041.
Diamond:			
Gem, not set or strung—thousand carats	1,439	5,180	United Kingdom 5,025.
Industrial—do	563	1,990	All to United Kingdom.
Diatomite and other infusorial earth	64	21	Venezuela 16; Mozambique 3; Angola 2.
Feldspar, leucite, nepheline, etc	7,800	3,000	Italy 1,651; United Kingdom 850; Spain 299.
Fertilizer materials, natural and manufactured:			
Nitrogenous	190,479	243,020	Venezuela 33,000; Libya 19,606; Brazil 15,800.
Phosphatic	71,485	64,630	Brazil 40,762; Indonesia 12,063.
Potassic	442	3	All to Angola.
Other, including mixed	4,022	4,068	Angola 3,053; West Germany 1,000.
Ammonia	49,449	58,128	Spain 45,870.
Graphite, natural	6	13	Angola 8; Mozambique 5.
Gypsum and plasters	125	49	Mozambique 27; Cape Verde Islands 7.
Lime	620	439	Mozambique 153; Guyana 105.
Magnesite	(1)	2	All to Angola.
Mica, all forms	NA	NA	
Pigments, mineral:			
Natural, crude	86	88	West Germany 23; Mozambique 19.
Iron oxides, processed	67	24	Mozambique 9; Guyana 4; Angola 3.
Pyrite (gross weight)	94,426	61,820	Belgium-Luxembourg 46,525; West Germany 15,295.
Salt	466	568	São Tomé e Príncipe 319; Angola 140; Finland 60.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	4,404	3,274	Angola 1,550; Spain 906; Zambia 401.
Caustic potash, sodic and potassic peroxides	4	5	Guyana 2; Cape Verde Islands 1; Angola 1; Timor 1.

See footnotes at end of table.

Table 2.—Portugal: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Marble and other calcareous	132,510	105,966	Italy 30,416; Spain 29,650; Belgium-Luxembourg 16,823; West Germany 15,066.
Slate	8,141	6,240	Belgium-Luxembourg 2,734; Denmark 1,144; Netherlands 741.
Granite and other	17,605	25,426	Italy 20,359; Japan 2,175.
Worked:			
Slate	8,014	7,110	Netherlands 2,325; Belgium-Luxembourg 1,563; West Germany 985.
Paving and flagstone	133,036	96,914	West Germany 53,732; United Kingdom 11,625.
Marble and other	23,277	29,862	West Germany 16,103; United Kingdom 2,990.
Dolomite, chiefly refractory grade	NA	NA	
Gravel and crushed rock	12,277	43,970	Gibraltar 38,550.
Limestone (except dimension)	95	145	São Tomé e Principe 94; Mozambique 22.
Quartz and quartzite	97,553	59,847	Norway 44,088; Italy 11,350.
Sand, excluding metal bearing	64,123	66,140	Gibraltar 34,330; Italy 31,100.
Sulfur:			
Elemental, all forms	4	NA	
Sulfuric acid	27,806	6,546	Turkey 6,000.
Talc, steatite, soapstone, pyrophyllite	71	21	Angola 17; Mozambique 4.
Other nonmetals, n.e.s.:			
Slag, dross and similar waste, not metal bearing, from iron and steel manufacture	10	1,000	All to France.
Oxides and hydroxides of magnesium, strontium, and barium	NA	NA	
Bromine, iodine, fluorine	1	NA	
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	2,475	2,025	Cape Verde Islands 962.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	874	24	Mozambique 20; Angola 2.
Carbon black	8	2	Angola 1.
Coal, all grades, including briquets	99	NA	
Coke and semicoke	15,079	16	Cape Verde Islands 15; West Germany 1.
Hydrogen and rare gases	(1)	(1)	NA.
Petroleum refinery products:			
Bunker deliveries:			
Gasoline, aviation thousand 42-gallon barrels	6	5	Foreign flag vessels and aircraft.
Kerosine do	(1)	(1)	
Jet fuel do	1,126	946	
Distillate fuel oil do	364	22	
Residual fuel oil do	339	593	
Lubricants do	33	13	
Total do	1,868	1,579	
Nonbunker deliveries:			
Gasoline:			
Aviation do	44	NA	
Motor do	230	43	Guyana 34; Cape Verde Islands 9.
Kerosine do	56	70	Angola 23; Guyana 23; Cape Verde Islands 16.
Jet fuel do	4	8	All to Guyana.
Distillate fuel oil do	815	NA	
Residual fuel oil do	772	NA	
Lubricants do	209	140	United Kingdom 40; Spain 40; Belgium-Luxembourg 20; Cuba 13.
Other:			
Liquefied petroleum gas do	14	12	NA.
Mineral jelly and wax do	33	39	Cape Verde Islands 24.
Unspecified do	6	(1)	NA.
Grand total do	4,051	1,891	

NA Not available.
[1] Less than ½ unit.

Table 3.—Portugal: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	20	1,300	All from France.
Metal including alloys, all forms:			
Scrap	640	44	United States 7; Gibraltar 5; Sweden 5; West Germany 2.
Unwrought	6,619	4,776	Norway 1,973; Spain 1,495; France 699.
Semimanufactures	26,154	9,228	West Germany 2,413; Austria 1,457; Belgium-Luxembourg 1,254.
Beryllium:			
Beryl ore and concentrate	27,772	383	Republic of South Africa 152; Netherlands 72; United Kingdom 54; Australia 50.
Metal including alloys, all forms	(1)	NA	
Chromium:			
Chromite	556	57	United Kingdom 20; Netherlands 19; Finland 18.
Oxide and hydroxide	215	112	Mainly from West Germany.
Cobalt oxide and hydroxide	13	5	Belgium-Luxembourg 3; West Germany 1; United Kingdom 1.
Copper:			
Ore	5	50	All from Australia.
Copper sulfate solution	1,031	311	United Kingdom 311.
Metal including alloys:			
Scrap	337	NA	
Unwrought:			
Blister	1,520	1,345	All from Zambia.
Refined, unalloyed	6,851	8,740	Canada 3,846; Belgium-Luxembourg 3,149; United Kingdom 1,043.
Other	1,433	498	United Kingdom 360; Angola 72.
Semimanufactures	13,414	6,959	United Kingdom 1,961; West Germany 1,571; France 1,270; Italy 995.
Gold metal, unworked or partly worked troy ounces	4,598	2,958	United States 1,608; Belgium-Luxembourg 804.
Iron and steel:			
Ore and concentrate	[2] 417,841	386,028	Brazil 143,489; Angola 96,000; Canada 79,262; Republic of South Africa 61,938.
Metal:			
Scrap	8,113	5,482	United States 3,547.
Pig iron, ferroalloys, similar materials	45,060	35,959	Spain 25,527; West Germany 2,765.
Steel primary forms	274,656	85,955	Japan 49,408; Netherlands 16,823; West Germany 14,524.
Semimanufactures:			
Bars, rods, angles, shapes, sections	173,804	121,134	Belgium-Luxembourg 36,920; West Germany 24,003; Japan 14,711; Sweden 12,937.
Universals, plates, sheets	249,874	193,445	Japan 68,962; West Germany 28,842; Italy 24,457; France 21,234; Belgium-Luxembourg 20,690.
Hoop and strip	53,240	23,108	Belgium-Luxembourg 8,538; West Germany 8,113; France 2,950.
Rails and accessories	32,025	26,882	Belgium-Luxembourg 15,987; France 8,699.
Wire	18,272	15,609	West Germany 3,322; Belgium-Luxembourg 3,298; United Kingdom 3,195; France 1,806.
Tubes, pipes, fittings	31,412	29,733	West Germany 11,722.
Castings and forgings, rough	908	637	West Germany 188; United Kingdom 86.
Lead:			
Oxides	302	54	United Kingdom 45; West Germany 9.
Metal including alloys:			
Scrap	263	77	Gibraltar 66; United States 6.
Unwrought	14,086	8,362	United Kingdom 4,984; Mexico 2,045.
Semimanufactures	359	47	Belgium-Luxembourg 19; United Kingdom 12; West Germany 8.

See footnotes at end of table.

Table 3.—Portugal: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Magnesium metal including alloys, all forms	9	5	Netherlands 3; West Germany 1; Austria 1.
Manganese:			
Ore and concentrate	508	50,617	Republic of South Africa 30,874; Ghana 10,009; Gabon 9,734.
Metal including alloys, all forms	538	282	Belgium-Luxembourg 95; Japan 80; United Kingdom 76.
Mercury ----76-pound flasks	580	435	Yugoslavia 203; Italy 145; Spain 87.
Molybdenum:			
Ore and concentrate ----kilograms	20,000	NA	
Metal including alloys, all forms--do	1,900	600	West Germany 200; Netherlands 200; Austria 200.
Nickel metal including alloys:			
Scrap	47	142	Canada 115; West Germany 24.
Unwrought	80	71	West Germany 30; Belgium-Luxembourg 10; United Kingdom 10; France 9.
Semimanufactures	560	317	United Kingdom 120; West Germany 111; Finland 35.
Platinum-group metals and silver:			
Waste and sweepings ----troy ounces	64	96	United Kingdom 32; Netherlands 32.
Metals including alloys:			
Platinum group ----do	5,541	2,743	United Kingdom 1,447; West Germany 707.
Silver ----thousand troy ounces	1,407	450	West Germany 161; United Kingdom 96; Switzerland 64.
Rare-earth metals:			
Oxides	12	11	France 8; United Kingdom 2.
Metal including alloys ----kilograms	11,000	NA	
Tin:			
Oxides	14	16	West Germany 8; United Kingdom 5; France 2.
Metal including alloys:			
Scrap	(1)	2	NA.
Unwrought	481	307	United Kingdom 148; Malaysia 71; Netherlands 53; Belgium-Luxembourg 30.
Semimanufactures	60	18	Netherlands 7; West Germany 4; Spain 4.
Titanium:			
Ore and concentrate, rutile	259	180	United Kingdom 149; Australia 31.
Oxides	5,531	2,832	United Kingdom 1,044; Finland 757; West Germany 451.
Tungsten metal including alloys, all forms	(1)	NA	
Zinc:			
Ore and concentrate	10	NA	
Oxide	342	112	United Kingdom 33; West Germany 26; Belgium-Luxembourg 15; Sweden 12.
Metal including alloys:			
Scrap	145	36	United Kingdom 19; Spain 11; Gibraltar 5.
Blue powder	151	47	Norway 33; United Kingdom 14.
Unwrought	11,463	8,131	Belgium-Luxembourg 3,858; Denmark 1,570.
Semimanufactures	1,385	859	West Germany 448; Belgium-Luxembourg 152; United Kingdom 99.
Other:			
Ore and concentrate:			
Of titanium, vanadium, zirconium	1,069	734	Australia 299; United States 275; United Kingdom 139.
Of base metals, n.e.s	176	169	Austria 99; Australia 50; United Kingdom 20.
Oxides, hydroxides and peroxides, of metals, n.e.s	2,320	1,939	United Kingdom 1,736.
Metals including alloys, all forms:			
Metalloids	413	677	Spain 585.
Alkali, alkaline earth, rare-earth metals ----kilograms	12,400	200	All from West Germany.
Pyrophoric alloys	4	2	Austria 1.

See footnotes at end of table.

Table 3.—Portugal: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Other—Continued			
Metals including alloys, all forms—Continued			
Base metals including alloys, all forms, n.e.s	113	119	People's Republic of China 45; Australia 20; United Kingdom 12; Belgium-Luxembourg 12.
NONMETALS			
Abrasives:			
Natural, n.e.s.:			
Pumice, emery, natural corundum, etc	530	239	Netherlands 122; West Germany 37; Denmark 29.
Dust and powder of precious and semi-precious stones (including diamond) kilograms	30	20	United Kingdom 15; Netherlands 2.
Grinding and polishing wheels and stones	569	308	United Kingdom 73; Italy 55; West Germany 52; Spain 51.
Artificial corundum	935	581	France 248; West Germany 219; Austria 68.
Asbestos	9,653	5,778	Canada 1,673; Republic of South Africa 1,079; Italy 791.
Barite and witherite	1,702	2,135	Netherlands 1,040; Italy 992.
Boron materials:			
Crude natural borates	1,358	785	Netherlands 780.
Oxide and acid	259	290	United States 120; France 91; Belgium-Luxembourg 36.
Cement	12,063	1,588	West Germany 528; France 378; Italy 308; Norway 213.
Chalk	6,344	5,887	Spain 2,426; France 1,991; United Kingdom 836; Belgium-Luxembourg 634.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Bentonite	9,548	11,121	Spain 6,583; Netherlands 831; United States 710.
Kaolin	7,406	4,760	United Kingdom 2,816; France 1,597.
Other	7,518	64	Italy 20; United States 20; West Germany 18.
Products:			
Refractory (including nonclay bricks)	9,154	8,183	West Germany 2,592; Denmark 1,161; France 1,021.
Nonrefractory	6,774	1,585	Spain 1,056; Italy 405.
Cryolite and chiolite	80	30	All from Denmark.
Diamond, except powder and dust:			
Gem, not set or strung—thousand carats	6	15	Mainly from Belgium-Luxembourg.
Industrial —do—	2	(1)	NA.
Unclassified —do—	2,186	1,095	Angola 1,060.
Diatomite and other infusorial earth	3,847	2,772	Spain 1,788; United States 547; West Germany 261.
Feldspar, leucite, nepheline, etc	1,543	2,301	Spain 1,642; United Kingdom 649.
Fertilizer materials:			
Crude:			
Nitrogenous	1,537	1,130	All from Spain.
Phosphatic	308,100	28,960	Morocco 18,520.
Manufactured:			
Nitrogenous	3,753	1,801	Spain 1,132.
Phosphatic	8,826	2,834	Belgium-Luxembourg 1,788; France 1,044.
Potassic	53,247	35,109	France 10,759; West Germany 9,799; Spain 8,771.
Other including mixed	9,293	17,136	Belgium-Luxembourg 4,814; United States 4,203; West Germany 4,159; Spain 2,315.
Graphite, natural	286	217	United Kingdom 156.
Gypsum and plasters	24,411	21,136	Morocco 18,520.
Iodine	5	7	Japan 6; Italy 1.
Lime, hydraulic	16	11	All from France.
Magnesite	618	1,291	Italy 617; United Kingdom 310; Netherlands 183.

See footnotes at end of table.

Table 3.—Portugal: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Mica:			
Crude including splittings and waste	294	314	Norway 286.
Worked including agglomerated splittings	16	15	Switzerland 8; Spain 3; Belgium-Luxembourg 2.
Pigments, mineral:			
Natural, crude	56	22	France 20.
Iron oxides, processed	2,101	1,577	West Germany 824; Spain 567.
Salt and brine	48,326	33,045	Italy 25,430; Netherlands 7,572.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	82	44	Sweden 19; Italy 15; France 6.
Caustic potash, sodic and potassic peroxides	204	360	Italy 273.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	2,562	1,804	Angola 1,803.
Worked	231	92	Spain 41; Italy 35; Belgium-Luxembourg 14.
Dolomite, chiefly refractory grade	4,443	4,140	Italy 2,470; Norway 1,038; Spain 592.
Gravel and crushed rock	136	253	Italy 114; France 59; Denmark 41; Spain 27.
Quartz and quartzite	288	262	Sweden 130; Belgium-Luxembourg 45; West Germany 44.
Sand excluding metal bearing	9,332	6,307	Belgium-Luxembourg 3,612; Spain 2,389.
Sulfur:			
Elemental:			
Other than colloidal	30,078	27,280	France 25,715.
Colloidal	169	45	West Germany 43.
Sulfur dioxide	289	249	West Germany 113; Netherlands 103.
Sulfuric acid	28,422	25,535	Poland 11,739; West Germany 8,399; Belgium-Luxembourg 5,091.
Talc, steatite, soapstone, pyrophyllite	3,399	2,685	France 1,245; Norway 600.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet	(1)	NA	
Other	8,718	900	Spain 376; Mozambique 251.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture	31,086	4,002	All from France.
Slag and ash, n.e.s	2	2	All from West Germany.
Oxides and hydroxides of magnesium, strontium, barium	2,111	2,737	Netherlands 1,347; United Kingdom 1,272.
Bromine and other halogens (excluding iodine)	NA	11	Japan 10.
Building materials of asphalt asbestos, and fiber cement and unfired nonmetals, n.e.s	1,776	927	Spain 359.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,278	273	Spain 134; France 101.
Carbon black and gas carbon:			
Carbon black	8,777	7,204	Spain 2,769; France 2,676; West Germany 759.
Gas carbon	30	NA	
Coal, all grades including briquets thousand tons	297	373	United States 240; Poland 117.
Coke and semicoke do	51	37	United Kingdom 20; France 9; West Germany 5.
Hydrogen and rare gases do	13	8	Italy 3; Netherlands 3; United Kingdom 2.
Peat including peat briquets and litter do	865	710	Netherlands 339; West Germany 195; Spain 87.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	41,738	38,885	Iraq 18,739; Iran 9,478; Saudi Arabia 4,963; U.S.S.R. 4,529.
Refinery products:			
Gasoline:			
Aviation do	220	68	Netherlands 43.
Motor do	1,363	145	Netherlands 51; Italy 51.
Total do	1,583	213	

See footnotes at end of table.

Table 3.—Portugal: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum—Continued			
Refinery products—Continued			
Kerosine and jet fuel thousand 42-gallon barrels	857	357	United Kingdom 132; Italy 93; Spain 78.
Distillate fuel oil ---do---	1,551	880	Netherlands 351; United Kingdom 194; Italy 142.
Residual fuel oil ---do---	2,330	2,471	Venezuela 673; United Kingdom 326; Netherlands 266.
Lubricants ---do---	150	53	France 13; Netherlands 13; United Kingdom 13; Belgium-Luxembourg 7.
Other:			
Liquefied petroleum gas ---do---	2,948	2,749	Netherlands 1,067; France 789; United Kingdom 360; Belgium-Luxembourg 278.
Mineral jelly and wax ---do---	26	8	NA.
White spirit ---do---	18	2	Netherlands 1.
Unspecified ---do---	419	189	Netherlands Antilles 84; Spain 77.
Grand total ---do---	9,882	6,922	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	10,604	6,930	Netherlands 2,199.

NA Not available.
[1] Less than ½ unit.
[2] Includes pyrite.

COMMODITY REVIEW

METALS

Iron and Steel.—The new national plan for steel called for tripling the present steel output of about 400,000 tons per year. A new steel plant was to be built by the French company, Sofresid, but there were no details on location and capacity; a 1.5-million-ton-per-year mine at Moncorvo (northern Portugal) was to supply iron ore. To assure faster development, the Moncorvo project will be transferred to a public company to implement the development. However, the problem of transportation of Moncorvo ore to the plant at Seixal or any other possible site remained unresolved, since the area where mining was planned is remote and lacks roads and railroads. It is expected that economic aid from the European countries and the United States will be needed for further development of the steel industry.

During 1976, two iron ore mines and two manganiferous iron ore mines (8.5% Mn) were in production. Siderurgia Nacional S.A.R.L., with a plant at Seixal, remained the major iron and steel producer in the country.

Pyrites.—Total utilization of pyrites with recovery of sulfur, copper, lead, and zinc, and production of iron pellets from cinder was the essence of the national plan for pyrites published during 1976 (Decreto No. 441/76 of June 4, 1976).

Pyrite reserves of Alentejo Province were estimated in the plan at 240 million tons of which 33 million tons were proven. Pyrite produced in this area has the following average content: Sulfur, 41% to 46%; copper, 0.8% to 1.6%; iron, 39%; lead, 0.9% to 1.2%; and zinc 2.2% to 3.4%. Two deposits, Aljustrel (80 kilometers east of Sines) and Lousal Caveira (about 36 kilometers north of Aljustrel), were in production; the Government of Portugal owned 90% of the operating company, Piritas Alentejanas.

During the 1970's production from both deposits was about 500,000 tons per year and employment was 1,300 persons. Aljustrel accounted for about two-thirds of the total output. Production was sold largely to two Portuguese companies, Companhia União Fabril (CUF) and Amoniaco Portugués, for production of sulfuric acid used in fabrication of fertilizers.

The cinder left after roasting was originally sold to Siderurgia Nacional, but the high lead content made it unusable and about 700,000 tons remained at yearend at

CUF's Barreiro facilities. To improve utilization of pyrite and use the large stocks of cinder, CUF was preparing to construct an installation for recovering nonferrous metals and producing iron pellets by the Japanese Kowa-Seiko method. A yearly output was planned as follows: Iron pellets, 342,000 tons (about 50% of consumption in the Siderurgia Nacional steel plant at Seixal); copper, 1,200 tons; lead, 2,100 tons; zinc, 4,200 tons; gold, 200 kilograms; and silver, 4,000 kilograms. In addition, a new 250,000-ton-per-year sulfuric acid plant was included in the project. Partial financing for a pelletizing plant has been assured through a $23 million loan from the European Investment Bank of the European Community.

To meet future increased demand for pyrite, the Government of Portugal examined possibilities for expanding the productive capacity of the Aljustrel mines. Plans for the expansion have not been completed, but the Government's Pyrite Commission foresees two phases of development. During the first phase (1978–81) the annual output of the Aljustrel mine should increase from 0.4 million tons to 1.4 million tons of pyrite at a cost of $140 million. Approximately $60 million will be for mining equipment. During the time of mine expansion, the Commission will determine the best metallurgical method for recovery of elements from the pyrite, and construction of the metallurgical plant should follow. Additional estimated costs for the metallurgical project were reported at $149 million. When the Aljustrel project is completed, mining and processing of pyrite should generate a total revenue of $203 million per year.

Tungsten.—Tungsten remained the most important mineral commodity produced in the country. To assure continuous production, additional prospecting for scheelite was conducted in the areas of Freixo de Espada a Cinta, Caminha, and Taronca. The Bureau de Recherche Geologique et Minière of France and Union Carbide Corp. were most active in tungsten exploration.

Other Metals.—A silicon metallurgy plant, owned by Milnorte S.A.R.L., was under construction near Regua. Production will be based on large reserves of quartz sand in the area. Completion date and capacity of the plant are not known.

During 1976, uranium resources were reexamined by the Portugueses Junta Nuclear. The Niza area and the red sands north of Coimbra were considered for production. However, no decision on the future of these resources was made public by yearend.

NONMETALS

Nonmetallic materials such as cement, ornamental stone, clays, gypsum, sand, gravel, feldspar, lime, lithium minerals, salt, and talc were produced in the country. Except for ornamental stone, which is exported, nonmetals are used domestically and their output was significant only to the domestic economy.

The possibility of starting production from the large sand deposits of Rio Major and the Setubal Peninsula was explored during the year.

Cement.—Five cement plants with 16 kilns and a total annual capacity of 3.5 million tons were operational during 1976. Two companies, Companhia Cimento Tejo S.A.R.L. and Companhia Geral de Cal e Cimento S.A.R.L., accounted for 50% of the country's cement output.

Stone.—About 300 stone-producing facilities were in production during 1976; employment averaged about 3,000 persons. A large variety of stone was produced; however, ornamental stone, marble, and granite remained the most important products, and significant quantities were exported to Italy for further processing. The area around Villa Vicosa-Borba-Estremos remained the major producer and accounted for about 70% of the total output.

MINERAL FUELS

Portugal's supply of fuels remained dependent on imports, mostly petroleum and petroleum refinery products. Some high-rank coal and coke were also imported. Coal, mostly anthracite, remained the principal source of energy produced in Portugal. Table 4 shows supply and apparent consumption of fuels and power in 1974 and 1975.

Coal.—Production of coal came from a mine located near Oporto. During 1976, production remained at the 1975 level, about 200,000 tons per year.

Natural Gas and Petroleum.—Portugal was completely dependent on imports of gas and oil to meet its requirements. To

Table 4.—Portugal: Supply and apparent consumption of fuels and power for 1974 and 1975 [1]

(Million tons of standard coal equivalent)[2]

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Peat, fuelwood, and other fuels	Hydroelectric power	Nuclear power
1974:							
Production	1.2	0.2	--	--	--	1.0	--
Imports	r 8.1	.4	r 7.3	(3)	0.3	.1	--
Exports	.7	--	--	(3)	--	.7	--
Apparent consumption	8.6	.6	r 7.3	(3)	.3	.4	--
1975:							
Production	1.2	.2	--	--	--	1.0	--
Imports	10.5	.6	9.4	(3)	.3	.2	--
Exports	1.1	(3)	.5	(3)	--	.6	--
Apparent consumption	10.6	.8	8.9	(3)	.3	.6	--

r Revised.
[1] Includes nonenergy uses.
[2] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[3] Less than 0.1 million tons of SCE.

correct the situation, the Government took steps to stimulate interest in offshore exploration for oil and gas. A new Government organization was formed to oversee the exploration work and speed the Government's decisionmaking process.

Eight wells were drilled offshore Portugal during 1976; all were dry. Shell-Sacorex drilled three of these wells north of Lisbon with depths ranging from 2,300 meters to 2,600 meters; and Texaco also drilled three wells in the Cavala concession north of Oporto with depths between 1,200 meters and 1,700 meters. Two wells were drilled off the south coast, one by Challenger to a depth of 3,100 meters, and one by the Chevron-Geosul-Petrograbe consortium to 2,500 meters.

Construction continued on a new 6-million-ton-per-year refinery at Sines, 90 kilometers south of Lisbon, to replace the refinery at Lisbon. Total Portuguese refinery capacity will then be 15 million tons per year, far above domestic demand, and an export market for surplus petroleum products will have to be found. Two refineries with an annual capacity of about 9 million tons operated in Portugal and processed about 5 million tons of crude oil. Approximately 25% of the products were exported to various countries in Europe.

The Mineral Industry of Southern Rhodesia

By Janice L. W. Jolly [1]

Mineral production in Southern Rhodesia contributed about 12% to the nation's gross domestic product (GDP) estimated at $3,123 million [2] in 1976. Only the mineral and agricultural sectors showed real growth in output during the year. The overall real GDP declined 3.4% in 1976, compared with a 7.7% growth rate in 1975. The Southern Rhodesian Government continued to encourage both large and small mineral investors, in the belief that mining potential was best developed by private enterprise and that the profit motive provided the basic stimulus to economic activity. The Government provided prospecting grants, development grants, and loans to stimulate new projects; private prospectors were particularly encouraged.[3] A very active geological survey has been maintained which has mapped most of the country in detail and is expected to embark soon on a regional geophysical survey of the country, involving gravitational, magnetic, radiometric, and geochemical surveys. An Institute of Mining Research was also maintained by the Government.

There was a general decline in the volume of manufacturing production in both 1975 and 1976, with that of 1976 down 10%. Recession in the construction industry was a major factor in the slack capital goods demand. Increased limitations on foreign exchange, fuel rationing, and shortages of skilled manpower also had an effect.

Mozambique closed its border with Southern Rhodesia on March 8, 1976, confiscating many Southern Rhodesian railcars. The impact of this move was less than originally expected as exports were shifted to the South African rail system and ports. Southern Rhodesia was making greater use of the Beitbridge route, and only some 25% of its traffic was moving through the Botswana rail route after the closure. Southern Rhodesian traffic was competing with an estimated 30% of Zairian traffic also moving through Botswana. Additional transportation problems were caused when African Nationalist guerrillas blew up a railroad bridge in northwestern Southern Rhodesia in October 1976, plunging 11 cars loaded with Zairian copper into a river near the town of Matetsi.[4]

The third symposium on minerals was held at the University of Rhodesia in Salisbury in September 1976 and was attended by about 160 geologists, mainly from Southern Rhodesia and the Republic of South Africa, but also from Canada, West Germany, Australia, France, Botswana, and the Territory of South-West Africa. The first symposium in 1968 was on the Southern Rhodesian basement complex. The second one in 1971 was on granite.

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[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Southern Rhodesian dollars (R$) to U.S. dollars at the rate of R$1=US$1.60.

[3] Chamber of Mines Journal (Salisbury). What They're Saying About Us. January 1977, p. 27.

[4] Financial Times (London). Guerrillas Destroy Rhodesia Rail Link. Oct. 8, 1976, p. 5.

PRODUCTION AND TRADE

Mineral production was valued at $368.8 million in 1976, compared with $271.7 million for 1975. Both the mineral unit value and volume indexes (1964=100) increased in 1976, 26% and 7%, respectively. In the past decade, the value of Southern Rhodesian mineral production has increased over 250%.[5]

Prior to the Unilateral Declaration of Independence (UDI) in 1965, foreign trade was mainly with the United Kingdom, Zambia, and southern African and European countries. Recent United Nations statistics indicated that some Southern Rhodesian exports continued after the UDI to several developed countries other than the Republic of South Africa, including Japan, West Germany, the Netherlands, Belgium, and Austria. Trade with central and southern African countries also continued to be important. Trade with the Republic of South Africa increased, and Southern Rhodesia's

[5] Work cited in footnote 3.

Table 1.—Southern Rhodesia: Production of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 [p]
METALS			
Antimony, mine output, metal content [e]	300	300	300
Beryllium, beryl concentrate, gross weight [e]	60	60	60
Chromium, chromite, gross weight [e] thousand tons	590	590	610
Columbium-tantalum minerals, tantalite, gross weight [e]	40	40	40
Copper: [2]			
Mine output, metal content	39,295	39,491	31,723
Metal:			
Smelter [e]	41,000	43,000	38,000
Refined [e]	30,000	30,000	30,000
Gold, mine output, metal content thousand troy ounces	800	800	800
Iron and steel: [e]			
Iron ore, gross weight thousand tons	600	600	600
Pig iron and ferroalloys do	[r] 480	[r] 510	510
Crude steel do	[r] 270	[r] 300	300
Nickel: [e]			
Mine output, metal content	11,500	14,000	15,000
Smelter [3]	10,000	[r] 9,000	10,000
Silver, mine output, metal content [2 4] thousand troy ounces	156	169	103
Tin: [e]			
Mine output, metal content	600	600	600
Smelter	600	600	600
Tungsten, mine output, metal content [2 5]	91	38	25
NONMETALS			
Asbestos [e] thousand tons	165	165	165
Cement, hydraulic do	754	677	541
Fertilizer materials, crude phosphate rock [e]	130,000	130,000	130,000
Fluorspar [e]	180	180	200
Lithium minerals, gross weight [e 2 6]	13,600	18,000	18,000
Magnesite [e]	20,000	20,000	20,000
Pyrite, gross weight [e] thousand tons	75	75	75
Stone, industrial limestone do	[e] 750	NA	NA
Sulfur:			
Content of pyrite do	30	30	30
Byproduct coal and/or metallurgy do	2	2	3
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous [7] do	2,794	2,581	2,926
Coke, metallurgical [7] do	267	[e] 270	[e] 270

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (including clays, stone, and sand and gravel) presumably were produced, but output is not reported quantitatively, and available information is inadequate to permit formulation of reliable estimates of output levels. Also, natural corundum, graphite, and mica have been produced in the past and output presumably has continued, but no basis for estimates of output levels is available. Through 1965, annual corundum output was at a level of several thousand tons, ranking Southern Rhodesia second only to the U.S.S.R. in world production.

[2] Data are for years ending Sept. 30 of that stated.

[3] Includes nickel content of nickel oxide and nickel fonte.

[4] Output of the Inyati mine only.

[5] Output of the Beardmore mine only.

[6] Data represent only an approximate order of magnitude.

[7] Data represent sales for years ending Aug. 31 of that stated.

changing relationship since the Mozambique border closure in March 1976 reinforced the importance of the Republic of South Africa as a trading partner. U.S. imports from Southern Rhodesia in 1975 were valued at about $60 million (up from $19.4 million in 1974) and comprised only nonfuel minerals. Ferroalloys were the principal U.S. imports, valued at $38.5 million. Other imports included nickel and its alloys ($9.1 million), crude asbestos ($2.3 million), and nonferrous metal ores and concentrates ($7.3 million). Complete data on Southern Rhodesian trade are not available.

COMMODITY REVIEW

METALS

Chromite.—One of the country's main chromite producers was Anglo American Corp. Rhodesia Ltd.'s Rhodesian Alloys Mining Division (RAMD), which operated the Vanad, Caesar, and Sutton mines. Since 1973, when Anglo American took over Rhodesian Vanadium Corp.'s mines, extensive developments and improvements have been made. It was estimated that some $2.9 million had been spent through March 1976.[6] A further sum of $1.8 million was earmarked for the year ending March 31, 1977. Most projects were concerned with underground development. Extensive overhaul work on the Vanad processing plant was also undertaken. Survey methods were reorganized, resulting in more detailed information for production planning. All RAMD mines also adopted the same basic mining methods, called resue stoping. A long-term mining technique, resue stoping involved nearly a year's work to develop each 800- by 304-meter section and is to result in a more efficient operation and increased productivity.

The Vanad mine was RAMD's top producer with seven underground sections. The incline shafts reached a depth of 350 meters as development continued. RAMD's concentrator and sorting plant were also situated at Vanad and handled fines (−2.54-centimeter) material from all three mines. Hard lumpy ore above this size with 47% Cr_2O_3 content constituted up to 13% of total ore and was delivered directly to the stockpile at the Sutton mine to be railed to Gwelo. At the Sutton mine, considerable expansion and development work has been carried out in the past 2 years, and production levels were approaching those at Vanad. The Sutton mine operated six underground sections. The Caesar mine was operating at a low production rate, but the mine had great potential. A reserve of 1.3 million tons of ore to a depth of 300 meters was established at the Caesar mine. Plans were for future output at Caesar to be greater than the combined output of the other two mines.

New furnaces for expanding charge chrome[7] production were to be installed at RAMD's ferrochrome plant in Gwelo. This was in an effort to switch RAMD's traditional production of high-carbon chrome, low-carbon chrome, and silicochrome to charge chrome as both low-carbon chrome markets and the tonnage outlets for chromite became more restricted. The plant included a 28-million-volt-ampere furnace for producing about 25,000 tons per year of high-carbon chrome, in addition to two 17-million-volt-ampere furnaces for producing 35,000 tons per year of silicochrome. Normally, the silicochrome was converted to 33,000 tons per year of low-carbon chrome in three furnaces totaling 22 million volt amperes. One or more of the older, smaller furnaces on low-carbon chrome was to be phased out as charge chrome production was introduced. Southern Rhodesia's other main ferroalloy producer, Union Carbide Rhomet, operated three furnaces totaling 45 million volt amperes with a capacity of about 100,000 tons per year of high-carbon and charge chrome.[8]

The United States imported an estimated 11% of total Southern Rhodesian chrome ore exports in 1976 and 21% of total ferrochrome exports. Estimated exports of chrome ore and ferrochrome to the United States as a percentage of total Southern Rhodesian exports of all commodities were

[6] Mining in Rhodesia 1976 (Salisbury). Rhodesian Alloys Mining Division. 1976, pp. 31–33.
[7] A variety of ferrochrome containing 50% to 70% chrome, 3% to 6% silicon, 6% to 8% carbon, 0.04% sulfur, and 0.03% phosphorus.
[8] South African Mining and Engineering Journal (Johannesburg). Furnaces for Rhodesia Chrome Production Expansion. February 1977, p. 59.

as follows: 1974—2%, 1975—8%, and 1976—4%.[9]

Copper.—The Minister of Mines announced that Southern Rhodesia had 1.2 million tons of copper reserves.[10] The low copper price was worrisome in 1976, but in general, the Southern Rhodesian copper industry still produced at a profit throughout much of the year.

The Messina (Transvaal) Development Co. Ltd. (M.T.D.) group of companies includes: M.T.D. (Mangula) Ltd., operating the Molly, Norah, and Silverside mines; Messina's own Beardmore mine (tungsten); Lomagundi Smelting & Mining (Pvt.) Ltd., operating the Alaska, Shackleton, Avondale, Angwa, Hans, and Gwai River mines; and Messina Rhodesia Investments Ltd. (Merits), operating several mines. M.T.D. (Mangula) enjoyed a successful year in 1976, declaring dividends totaling $8 million. The year's profits were boosted by sales of copper on which the production costs had been borne in previous years. To repeat this profit performance in 1977 would require higher copper prices.

M.T.D. (Mangula)'s performance was even more exceptional in view of an 8-week breakdown at the concentrator. One of two motors failed, resulting in a production loss of 96,000 tons of ore in May and June; the copper loss was 1,000 tons. The grade of ore taken from all three mines of M.T.D. (Mangula) was also slightly lower than anticipated, leading to a shortfall in production of some 1,200 tons of copper. Withdrawals from the concentrate stockpile at the Alaska smelter yielded production of over 950 tons of copper in excess of mine production, and this, combined with shortening of the pipeline, brought the sale tonnage to a satisfactory level.[11] The Silverside mine is expected to go out of production in 1977 as ore reserves were exhausted, but work was well advanced on doubling the concentrator capacity of the Norah mine to 42,000 tons per month and on boosting M.T.D. (Mangula)'s concentrator capacity 14%.[12]

Corsyn Consolidated Mines Ltd. speculated that unless there was a rise in the price of copper, the Inyati mine would have a short life. Losses were being incurred, and the mining position was subject to major policy changes which would include a further reduction in throughput. Other features apart from the low copper price were also significant. Payability was disappointing in some areas, and granite intrusives had affected ore reserves in the Era sections. Recovery of ore in areas affected by the pink granites was hazardous, expensive, and subject to dilution. The thickness (150 meters) of the flat-lying dolerite intrusive below the Era sections will have a severe effect on reserves in about a year. Shaft sinking through the dolerite made satisfactory progress, but an intersection with the gold reef was not expected until the end of the fiscal year when the grade and nature of the ore body would be known.

Gold.—The level of Southern Rhodesian primary gold output was estimated at 580,000 to 640,000 troy ounces per year from possibly 300 or more workings.[13] The four Coronation Syndicate Ltd. mines, Arcturus, Mashona Kop, Mazoe, and Muriel, produced 73,947 troy ounces in the year ending September 30, 1976. Blanket Mine (Pvt.), which was owned by Falconbridge Nickel Mines Ltd.'s subsidiary Ven- ounces of gold in 1976. There was also byproduct gold output from copper and nickel mining.

Southern Rhodesia's largest gold producer, Falcon Mines, produced 55,141 troy ounces of gold in fiscal year 1976, compared with 53,395 troy ounces in 1975. Working profit at the mine was $2.2 million in 1976, compared with $3.7 million in 1975. Falcon Mines operated five mining sections: Dalny, Arlandzer, Delcia and Beehive, Trukois, and Venice. During 1976, development footage was increased 30%; the average value and width of development were 11.4 grams of gold per ton and 160 centimeters. A major fault zone on the main Dalny ore body caused declining values. Ore reserves on September 30, 1976, were 1,081,000 tons averaging 12.5

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[9] U.S. Embassy, Dar es Salaam, Tanzania. State Department Telegram No. 080306, Apr. 8, 1977.

[10] Chamber of Mines Journal (Salisbury). Mr. Dillon Reviews Favorable Year. March 1976, p. 26.

[11] Chamber of Mines Journal (Salisbury). MTD Has a Very Successful Year. February 1977, p. 26.

[12] The Financial Times (London). Optimism at Mangula. Dec. 7, 1976, p. 33.

[13] Mining Annual Review, 1977 (London). Rhodesia. P. 445.

grams per ton over a width of 176 centimeters. A gold price of $113 per troy ounce was used in reserve calculations. Plans for 1977 called for a milling rate of 20,000 tons per month and a recovery grade of 7.5 grams per ton.[14]

Anglo American's Champion mine at Odzi was closing because ore reserves were exhausted. The mine was rehabilitated in 1973 after having been closed since 1964. Between April 1973 and December 1976, the Champion mine produced 9,721 troy ounces of gold and 10,993 troy ounces of silver for a total value of over $1,360 million. Champion produced its last gold bar at the end of December 1976.

Grandeur Gold Mining Co. was placed in provisional liquidation after delayed startup. In August 1976, the shareholders were notified that the mine was short of funds. The 250 shareholders were to lose a combined $300,000. The sharp drop in gold prices and the shortage of capital and working funds were the main causes. The mine could break even at a recovery grade of 4.5 grams per ton with a gold price of $112 per troy ounce. However, the recovery grade when the mine was placed under provisional liquidation was about 3 grams per ton. One hundred and ten miners were to lose their jobs.[15]

The Nantwich gold mine near Que Que was being dewatered and was to be mined by a new company, Nantwich Gold Mining Co. (Pvt.) Ltd. The main shareholder was Bradco Nominees. The mine was being worked on a tribute agreement with the South African owner. The lease was extended for 3 years with option to buy. The company had an authorized capital of $250,000 and would start underground operations in a month or two. Initial output was expected to be about 300 tons of ore per month with a grade of about 12 grams per ton.

The value of gold and silver recovered from concentrates treated at the Que Que roasting plant in the year ending March 31, 1976, totaled $981,000. A total of 125 troy ounces of gold and 254 troy ounces of silver was recovered from the re-treatment plant during the year. The plant showed a deficit for the year of $1,700, compared with a profit of $258 in the previous year.

The Vubachikwe mine, operated by the Forbes and Thompson Group, milled 5,500 tons of medium- to low-grade gold ore monthly. Very lenticular in character, the gold reefs were widely spread along the strike length, resulting in a labor-intensive operation consisting of small mines within a mine. Additional reserves were developed that would augment the present production; sinking to the 25th level was in progress. The Freda gold mine, also owned by Forbes and Thompson, milled 6,000 tons of low-grade ore monthly from a large ore body. The 16th level came into production during the year. A program of reclamation in the upper levels of the mine was planned. The company had taken an exclusive prospecting permit in an area adjacent to the Freda claims, and geological work was well advanced. The Old Lone Hand mine was pegged some 3 years ago, and a plant to treat the dumps at 3,000 tons per month was operational. Forbes and Thompson acquired a controlling interest in the Moghul mine near West Nicholson in November 1975, and an extensive underground development program was implemented. The mining and milling equipment was upgraded in capacity. The Big Ben mine was made administrative center for the Group.

Iron and Steel.—Rhodesian Iron and Steel Co., Ltd. (RISCO) officially completed the second stage of development at the steelworks complex in Redcliff in December 1976. The increase in employment resulting from the development was nearly 22% for Europeans and just over 31% for Africans. The second stage made it possible to more than double the production of finished and semifinished steel. The rolling mills and related facilities were extended and modernized to cope with the greatly increased production. There were 19 major areas of development. Preliminary studies were made in 1972, and the first civil engineering work at the steelplant and ironplant started in March 1973. Construction of the second-stage development was completed with the expansion of the coke oven battery in February 1976. Some of the difficulties experienced during the second-stage program were financial arrangements, inadequate port facilities at Maputo necessitating construction of a $14 million steel wharf, closure of the Mozambique border, serious design faults in parts of the plant,

[14] World Mining. What's Going On In World Mining. V. 30, No. 9, February 1977, p. 79.
[15] Chamber of Mines Journal (Salisbury). Grandeur Gold Mine In Liquidation. January 1977, p. 30.

and the lack of opportunity to train operators overseas. The plant was supplied by the Buchwa mine, which was soon to be expanded.

TA Holdings Ltd. acquired the 49% interest held by foreign shareholders in Africa Strip Mining Co. (Pvt.) Ltd., operators of the major iron ore mine at Buchwa.[16] TA Holdings held 51% of the equity of the company before the transaction. During the next 12 months, it was expected that development work at Buchwa would be completed and full production levels reached. Difficulties in removing the ore were reportedly owing to the ore becoming harder as mining progressed, which meant additional expenditures for heavier equipment. Also, the mine is situated in one of the wettest parts of the country making working conditions difficult for part of the year. RISCO had to use a new source at South Hill to meet short-term needs until the Buchwa operation reached full production. Meanwhile, TA Holdings intended to proceed with development and bring the mine into full production as soon as possible.

Lead.—A new lead recovery plant was completed at Douglas Road, Workington, on December 6, 1976. The plant was used for the removal of lead dust from waste. The lead dust was recycled and made available as a raw material for secondary lead smelters to make antimonial unblended lead and soft lead for refining into pure lead.[17]

Nickel.—Ore milled at Johannesburg Consolidated Investment Co. Ltd.'s (JCI) Shangani mine was 418,000 tons for the year ending June 30, 1976. The ore-milling rate was raised above the design capacity of 75,000 tons per month in order to compensate for lower than expected nickel and copper recoveries. There were few mechanical problems during trial milling phases, and the initial metallurgical problems encountered were overcome with the concentration process working satisfactorily. Even so, nickel recovery was below target because of a high oxide-to-sulfide ratio in the ore. The nickel recovery was expected to improve as mining extended below the oxidized zone. In the open pit, 6.5 million tons of ore and overburden was mined, and underground mine planning was continuing. Prospecting was temporarily discontinued because of large reserves already indicated. A sharply undulating footwall contact, with a high nickel concentration in the first few meters above the contact, was indicated by drilling and pit exposures. The ore body inclined an average of 35° and ranged in width from a few meters at the extremities to about 80 meters at the center. The eastern ore body was open ended in depth with the possibility of finding additional reserves.

Rio Tinto (Rhodesia) Ltd. declared a net profit of $2.89 million for the 9 months ending September 30, 1976, down slightly from that of the comparable 1975 period.[18] Most of the profit came from the Empress mine. Rio Tinto's Perseverance mine made no contribution during the year, as operations were suspended during 1975 because of metallurgical problems. Research and experiments were being carried out to improve recovery techniques. Rio Tinto was to build a new cobalt plant to treat residues from the Empress mine, and a crushing and materials-handling plant was to be built at the smelter. There was also to be a new refinery residues processing unit before resmelting. The unit was expected to improve efficiency and overall recovery of metal. The cobalt plant production was to start by the end of 1977.

Rhodesian Nickel Corporation Ltd. (Rhonick), an Anglo American subsidiary, owned the entire share capital of Trojan Nickel Mine Ltd., Madziwa Mines Ltd., and Bindura Smelting and Refining Co. Ltd. Rhonick's assets totaled almost $77 million. Capital expenditures by Rhonick over the last 18 months totaled about $26 million. Rhonick also operated the new Epoch mine, which started production in January 1976 at a cost of $9.6 million. The new-technology high-energy flotation process gave a boost to nickel recovery at Epoch. Through energizing the pulpy milled ore in conditioners, agitation was stepped up to increase the temperature of the liquid, making it easier to separate the nickel.[19] Production was on target and exceeded the

[16] Chamber of Mines Journal (Salisbury). TA Holdings Buys Buchwa. January 1977, p. 30.
[17] Chamber of Mines Journal (Salisbury). Minister Sees New Lead Recovery Plan. January 1977, p. 28.
[18] Chamber of Mines Journal (Salisbury). Tinto Records Higher Profit. January 1977, p. 28.
[19] Chamber of Mines Journal (Salisbury). Epoch Right on Target. October 1976, p. 27.

rated milling capacity of 25,000 tons per month. By the end of May 1976, the mine had milled almost 90,000 tons. Underground development was going ahead on three levels, and the stoping methods used on the Copperbelt were being applied on other levels. The service shaft was being deepened to 315 meters and was expected to be completed by March 1977.

Epoch's concentrates, which contained about 15% nickel and 0.05% copper, were sent to Bindura for smelting and refining. Nearly $14 million was spent on the Bindura smelter to enable the complex to handle the influx of concentrates from Epoch and from JCI's new Shangani mine. A new electric smelting furnace was commissioned in November 1975, and a new converter was commissioned in February 1976. Capacity of the refinery was uprated in April 1976. The capacity was estimated to be about 15,500 tons of nickel per year. In 1973, the smelter was rated at 7,500 tons of nickel per year.

The Trojan mine was Rhonick's largest mine, where, despite technical problems at the mill, 848,000 tons of ore was milled with an average mill-head grade of 0.68% nickel. Improved metallurgical techniques made possible higher nickel production from the concentrates. The mining layout and configuration were changed and improved over the past 2 years. At Madziwa, 483,000 tons of ore was milled in 1976, more than in 1975. Both ore grade and metallurgical recoveries showed an improvement, resulting in a 23% increase in the production of nickel in concentrates. The subvertical hoist chamber and shaft at Madziwa were almost complete, and an extensive short-range diamond-drilling program was started to evaluate and delineate the ore.

Ore reserves of Southern Rhodesian nickel mines are shown in table 2. This table does not include figures for nickel contained in the Great Dyke igneous complex, where sulfide horizons grading 0.25% nickel were estimated to contain 3.5 million tons of recoverable nickel, and where oxides grading 1.0% nickel suitable for direct smelting could yield another 1.4 million tons of nickel.[20] In addition, there were other less well-known prospects of the same type (nickel-copper sulfides in serpentinitic rocks). Probably the most advanced was the Hunters Road nickel prospect of Union Corporation Ltd. (Unicorp). Geological work, geochemical sampling, pitting, trenching, and diamond drilling have been done in detail at Hunters Road. A prospect shaft and development work were to be completed soon.

Tin.—The Kamativi tin mine celebrated its 25th anniversary in mid-1976 with the prospect of better times owing to improved metal prices. Kamativi was called locally the "miracle mine" because of its low-grade ore and financial success. About 100 tons of rock must be mined to produce 25 kilograms of tin.

Tungsten.—The distribution of tungsten ores in Southern Rhodesia is very wide, and scheelite is associated with gold in many areas, notably in the Bulawayo and Filabusi Districts and at Gwanda. At Essexvale, wolframite and scheelite were mined from veins in granite, associated with galena, chalcopyrite, and fluorite. At the mine at Tshantanda near Wankie, wolframite occurs with chalcopyrite in pegmatites; a similar mixture occurs at the Tung mine (some 8 kilometers northeast of

[20] Chamber of Mines Journal (Salisbury). American Editor Writes of Rhodesia's Remarkable Success. January 1977, pp. 26–27.

Table 2.—Southern Rhodesia: Ore reserves at nickel mines

Mine	Operator	Quantity (million metric tons)	Percent nickel	Date of estimate
Madziwa	Rhonick (Anglo American)	12	0.75	1975
Trojan	do	12	.70	1975
Epoch	do	2.5	.75	1975
Perseverance	Rio Tinto	2	1.25	1968
Empress	do	20	1.00	1965
Hunters Road	Unicorp	50	.75	NA
Shangani	JCI	16	1.00	1975

NA Not available.
Source: Chamber of Mines Journal (Salisbury). American Editor Writes of Rhodesia's Remarkable Success. January 1977, p. 27.

Tshantanda Siding). Tungsten concentrates were generally produced with a tungstic oxide (WO_3) content varying between 60% and 75%, upon which basis they were sold.

NONMETALS

Asbestos.—Southern Rhodesia remained the world's fifth largest asbestos producer, producing chrysotile, although official statistics have been unavailable since the UDI. Rhodesian & General Asbestos Corp. (Pvt.) Ltd. (RGA) operated the Shabanie, Gaths, Temeraire, and King mines in the Shabani and Mashaba Districts of Southern Rhodesia. RGA also owned asbestos-cement plants in Salisbury and Bulawayo. Pangani Asbestos Mine (Pvt.) Ltd. controlled the Bos Pangani, Rex, and Vanguard mines in the Bulawayo-Shabani area. The Kudu Mines (Pvt.) Ltd. asbestos mine near Essexvale was increasing its milling rate. A new asbestos ore body containing what was described as thick "packs" of exceptional quantity was discovered near Gwanda in shaft-sinking operations on a new section of the operating mine. Intersections of the ore, which was over 60 meters wide at the widest point, were made on three levels. The new ore body gave the mine an additional 6 years of life at the milling rate of 120,000 tons per month.[21]

Magnesite.—The Pande magnesite mine, located near Beitbridge, was being investigated along with similar nearby deposits. Mined by Vereeniging Refractories Ltd. of the Anglo American group, the Pande mine was considered to have a limited life. Modifications to the Pande operation to rework the waste dumps supplemented the rapidly diminishing reserves in the quarries. The group's underground magnesite mine at Gatooma had been unable to achieve its target in 1976 because of a shortage of rail trucks. Vereeniging's turnover last year was almost unchanged at $77.8 million, but profits dropped by about $960,000. Vereeniging was a major producer of refractory brick and roof tiles.

Pyrite.—Anglo American owned the Iron Duke mine near Mazoe. Started as a gold mine in 1914, the Iron Duke operations uncovered pyrite below the gold-bearing quartz 6 years later. The mine was the only pyrite producer in the country. This mineral was essential to sulfuric acid production consumed in the manufacture of fertilizer and in smelting operations. Anglo American geologists carried out an examination of the mine area and found a new ore body close to the mine with reserves estimated at 500,000 tons. This find increased pyrite reserves by over 1 million tons, prolonging the life of the mine.[22]

MINERAL FUELS

Coal.—Southern Rhodesia's only coal producer and one of the country's oldest mines, the Wankie coal operation, has been in production for 53 years. Anglo American acquired the operation as a highly developed coal producer in 1953, and productivity soared following an extensive program of mechanization after the takeover. Between 1971 and March 1976, the company spent about $38 million on replacements and major capital projects to modernize the operation.[23] These projects included the introduction of a new coke plant in 1971, new coal preparation and byproduct plants in 1972, and extensions to the coking coal plant and addition of the No. 4 colliery and a new slurry beneficiation plant in 1973. In 1974, extensive improvements were made to the coal preparation facilities and to the No. 4 colliery. By 1975, construction of special coal-loading facilities enabled the introduction of 36-truck liner trains to carry coke to the steel industry. A new drying and preheating plant was added for the cokeworks, along with other improvements to the crushing plant, beneficiation plant, and overland conveyor system.

At the beginning of 1976, an intensive 4-month campaign to increase coking coal throughput was started at Wankie. This resulted in a capacity improvement of 100% (from 70,000 tons to 140,000 tons per month). Wankie was operating two underground mines (Nos. 3 and 4) and three open cast areas (Nos. 1, 2, and 4). A fourth open cast operation (No. 3) was discontinued when the stripping ratio became excessive. The most economical open cast operation was No. 4, which had a low stripping ratio but a limited life, estimated to last until 1979. Production from the

[21] Mining Journal (London). Exploration. V. 290, No. 7432, Jan. 28, 1977, p. 66.
[22] Mining in Rhodesia 1976 (Salisbury). Iron Duke. 1976, p. 31.
[23] Mining in Rhodesia 1976 (Salisbury). Anglo Employs 13,000 Rhodesians. 1976, p. 29.

No. 4 pit was 312,224 tons in 1975. A total of 1,317,839 tons was produced in 1975 from the two underground mines. Underground mine No. 3 was the largest, with 823,492 tons produced. Total estimated coal production was 2.9 million tons.

A decline in the price of coal was to follow the signing of a new coal pact in early September 1976, allowing Wankie Colliery Co. sufficient profit to retain funds for capital expenditure. The agreement was for a 10-year period and dated back to September 1, 1975. The old agreement was based on a fixed profit margin for each ton of coal sold. This was changed to a return of capital employed of 12.5% after 1977. For the 1967–77 period, the pretax profit entitlement on Southern Rhodesian sales was to be increased to 10% of the capital employed. The return can be increased to a maximum of 15% to take some account of the tax payable. After 1977, the company would be able to take a maximum profit export sales of 5% of the capital employed.[24]

Total extractable Southern Rhodesian coal reserves were estimated at 744 million tons with 59% of the extractable material suitable for coking and about 220 million tons with higher ash content. In addition, there was a possible reserve of some 5 billion tons of coal and large reserves of carbonaceous shale with up to 60% ash. The coal could be utilized for steam raising and the carbonaceous shale for extraction of oil. Wankie coalfields had estimated reserves of 900 million tons, of which 300 million tons was extractable.[25]

Seven new coalfields were under investigation. Rio Tinto was reported to be investigating the Sengwa coalfield in the lowveld. Goldfields Ltd. was doing a feasibility study on the Bubi coalfield, located near Beitbridge, which was estimated to contain 15 million tons of high-grade coking coal.

[24] Chamber of Mines Journal (Salisbury). New Coalfields Investigated. October 1976, p. 25.
[25] Rhodesia Barclays National Review (Salisbury). Rhodesia. June 1976, p. 44.

The Mineral Industry of Romania

By Nikita Wells [1]

Romania's mineral resources have an important influence on the country's economy but are of little significance by world standards. Romania is primarily a producer of bituminous coal, lignite, crude oil, petroleum products, natural gas, crude steel, aluminum, cement, nitrogenous fertilizers, and salt. Domestic production supplies about one-half of the country's copper and about one-fifth of the iron ore requirements. The U.S.S.R. provides approximately one-half of Romania's coke and coking coal requirements, as well as 44% of the imported iron ore. Romania's crude oil production has leveled off, and in 1976, more than one-third of its crude oil requirements were imported from the Middle East, while Romania exported about an equal amount in petroleum products. Romania remains the only Council for Mutual Economic Assistance (CMEA) [2] country that does not import crude oil from the U.S.S.R.

During the current 5-year plan period (1976–80), Romania plans to open two new surface mines to produce low-grade copper ore and is to invest in some copper refineries and aluminum smelters. Aluminum and aluminum alloy production in 1980 is to increase 23% over that of 1976. In the iron and steel industry, crude steel production in 1980 is to be up 65% over that of 1976. This is to be achieved mainly by the expansion of the Galati iron and steel works and the operation of the new steel complex being erected at Călărasi on the Danube River.

In the nonmetals sector, Romania is to expand its cement production about 55% over that of 1976 by 1980. Most of the increase will result from the opening of the new cement plant at Taşca.

During the current plan period, Romania also expects to increase its crude oil and natural gas reserves by extensive deep drilling and offshore prospecting in the Black Sea. Romania's first offshore drilling rig was commissioned in 1976, and a second rig was in the planning stage.

Romania's total industrial production value in 1976 reached 661 billion lei,[3] an increase of 11.5% over that of 1975 and 1.3% over the planned figure. Ferrous metallurgy demonstrated a 7.6% increase, nonferrous metallurgy 11.6%, fuels 7.3%, and machine building and metal processing 12.2%.[4] Mineral production made up an estimated 7% of total industrial production.

In 1976, the national income reached 400 billion lei, a 10.5% increase over that of 1975. The development of the Romanian economy in 1976 was supported by investments totaling 149 billion lei (8.2% higher than in 1975). In 1976, labor productivity in industry increased 8.8% over that of 1975.[5]

Romania's total industrial labor force in 1976 was reported at 2.8 million persons. Of this number, 100,270 persons were employed in the fuel and power industry, 76,350 in the nonferrous metal industry, 812,490 in the engineering and metalworking industry, and 167,450 in the chemical industry.

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[1] Physical scientist, International Data and Analysis.

[2] Includes the following countries: Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.

[3] Values have not been converted from Romanian lei to U.S. dollars because of the wide variation between the 1976 official exchange rate (4.97 lei=US$1.00) and the tourist rate (12.00 lei=US$1.00).

[4] Scînteia (Bucharest). Feb. 6, 1977, pp. 1–3.

[5] Revista Economica (Bucharest). No. 6, Feb. 11, 1977, pp. 1–2.

PRODUCTION

In 1976, Romania continued to expand its iron and steel industry, showing a 12.4% increase in crude steel production and a 12.3% increase in pig iron production. Production of iron ore, however, decreased 7.5%. In the nonferrous metals sector, copper production increased 9.5% and that of aluminum metal increased 1.5%. In the nonmetals industry, cement production increased 8.9%, lime 8.4%, salt 9.8%, and nitrogenous fertilizer 3.0%.

The Romanian fuel sector in 1976 showed an 8.5% increase in natural gas production. Crude oil production increased less that 1% owing to the limit imposed by the Government to conserve depleting oil reserves. Total washed coal production in 1976 showed a decrease of 4.6% from that of 1975, owing mainly to the extensive program of overburden stripping carried out during 1976 to allow for the planned expansion of lignite mining in the current 5-year plan.

Production statistics for many mineral commodities are not reported by Romania, and therefore much of the data presented in table 1 are estimated.

Table 1.—Romania: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum:			
Bauxite, gross weight [e]	700,000	800,000	800,000
Alumina, gross weight [e]	374,000	400,000	400,000
Ingot (including alloys)	187,000	204,000	207,000
Bismuth, mine output, metal content [e]	80	80	80
Cadmium, smelter [e]	90	88	100
Copper:			
Mine output, metal content, recoverable	[e] 34,000	[e] 37,000	40,500
Smelter [e]	34,000	37,000	40,500
Refined [e]	34,000	37,000	40,500
Gold, mine output, metal content [e] ---troy ounces	60,000	60,000	60,000
Iron and steel:			
Iron ore ---thousand tons	3,265	3,065	2,835
Pig iron and blast-furnace ferroalloys ---do	6,081	6,602	7,415
Crude steel ---do	8,848	9,549	10,733
Semimanufactures:			
Castings and forgings, finished ---do	767	898	NA
Pipes and tubes ---do	973	1,151	1,213
Rolled products ---do	6,253	6,810	7,305
Lead:			
Mine output, metal content, recoverable	[e] 41,000	[e] 41,000	42,465
Smelter [e]	[r] 41,000	[r] 41,000	42,000
Manganese ore: [e]			
Gross weight	140,000	140,000	140,000
Mn content	34,000	34,000	34,000
Silver, mine output, metal content [e] --thousand troy ounces	1,100	1,500	1,300
Zinc:			
Mine output, metal content, recoverable	[e] 51,000	[e] 53,000	53,373
Smelter [e]	51,000	53,000	53,000
NONMETALS			
Barite [e]	116,000	116,000	116,000
Cement, hydraulic ---thousand tons	11,195	11,520	12,548
Chalk ---do	[e] 225	NA	NA
Clays:			
Bentonite [e]	62,800	62,800	65,000
Kaolin [e]	87,400	87,400	90,000
Refractory	[e] 492,500	NA	NA
Diatomite [e]	40,000	40,000	40,000
Feldspar [e]	58,200	58,000	58,000
Fertilizer materials, manufactured:			
Nitrogenous, N content ---thousand tons	980	1,292	1,331
Phosphatic, P_2O_5 content ---do	404	404	493
Fluorspar [e]	15,000	15,000	15,000
Graphite [e]	6,000	6,000	6,000
Lime ---thousand tons	3,071	3,064	3,320

See footnotes at end of table.

Table 1.—Romania: Production of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
NONMETALS—Continued				
Pyrite: [e]				
Gross weight	thousand tons	870	870	870
S content	do.	375	375	375
Salt	do.	3,923	3,833	4,210
Sand [e]		1,130	1,200	NA
Sodium and potassium compounds:				
Caustic soda	thousand tons	233	566	673
Sodium carbonate, manufactured, 100% Na_2CO_3 basis	do.	807	693	814
Sulfuric acid (monohydrate)	do.	1,358	1,448	1,555
Talc [e]		60,000	60,000	60,000
MINERAL FUELS AND RELATED MATERIALS				
Carbon black		78,384	86,447	91,282
Coal:				
Run-of-mine:				
Anthracite and bituminous	thousand tons	8,523	8,809	8,696
Brown	do.	683	660	600
Lignite	do.	20,001	19,916	18,819
Total	do.	29,207	29,385	28,115
Washed (produced from above):				
For coke and semicoke production	do.	1,525	1,845	1,924
Lignite	do.	19,141	19,155	18,164
Other (unspecified)	do.	6,232	6,091	5,754
Total	do.	26,898	27,091	25,842
Briquets produced from brown coal	do.	312	236	NA
Coke, metallurgical	do.	1,851	2,277	2,472
Gas:				
Manufactured (coke oven)	million cubic feet	33,443	[e] 33,600	[e] 37,000
Natural:				
Gross production:				
Associated	do.	219,762	222,658	222,940
Nonassociated	do.	855,211	953,527	1,053,573
Total	do.	1,074,973	1,176,185	1,276,513
Marketed production	do.	1,011,513	1,131,700	[e] 1,235,000
Petroleum:				
Crude:				
As reported	thousand tons	14,486	14,590	14,700
Converted	thousand 42-gallon barrels	107,964	108,739	109,559
Refinery products: [2]				
Gasoline	do.	29,325	34,408	38,395
Jet fuel and kerosine	do.	7,587	7,890	8,742
Distillate fuel oil	do.	40,523	41,112	46,901
Residual fuel oil	do.	40,320	39,887	50,829
Lubricants	do.	4,571	4,200	4,676
Other:				
Liquefied petroleum gas	do.	2,819	2,912	3,097
Asphalt	do.	3,539	3,697	3,951
Total	do.	128,684	134,106	156,591

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.
[1] In addition to the commodities listed, antimony, asbestos, gypsum, mica, and natural gas liquids, as well as a variety of crude construction materials, are produced, but output is not reported and available general information is inadequate to make reliable estimates of output levels.
[2] Romanian sources do not indicate whether or not refinery fuels are reported as a part of the listed product yields. Moreover, additional minor products may be produced but are not listed in official sources.

TRADE

Romania's foreign trade in 1976 registered a 14.5% increase over that of 1975. Exports were valued at 30.5 billion lei and imports at 30.3 billion lei.

In 1976, Romania imported 2.6 million tons of bituminous coal, 2.8 million tons of coke, 8.5 million tons of crude oil, 11.7 million tons of iron ore, 685,000 tons of apatite concentrate, and 109,500 tons of potassic fertilizer.

The only significant mineral exports in 1976 were 7.8 million tons of petroleum

products, 967,000 tons of rolled steel products, 77,600 tons of nonferrous metals, mostly aluminum, 1.93 million tons of nitrogenous fertilizers, and 2.7 million tons of cement.

In 1976, Romania's trade with CMEA countries was valued at 23,801 million lei, representing 39.1% of total trade. Romanian foreign trade by major commodity group for 1975 and 1976 was as follows:

	Value (million lei)		Percent of total	
	1975	1976	1975	1976
Exports:				
Metals, nonmetals, fuels	5,912	7,343	22.3	24.1
Building materials	772	921	2.9	3.0
Chemicals, fertilizers, rubber	2,857	2,526	10.8	8.3
Imports:				
Metals, nonmetals, fuels	10,153	12,409	38.2	41.0
Building materials	296	346	1.1	1.1
Chemicals, fertilizers, rubber	1,721	2,067	6.5	6.8

Source: Anuarul Statistic al Repblicii Socialiste România 1977 (Annual Statistics of the Socialist Republic of Romania 1977), Bucharest. 1977, pp. 430–431.

Romania's principal trading partners in 1975 and 1976 were as follows:

	Value (million lei)		Percent of total	
	1975	1976	1975	1976
U.S.S.R	9,858	10,864	18.6	17.9
Germany, West	5,039	4,644	9.5	7.6
Germany, East	2,909	4,254	5.5	7.0
Poland	2,073	2,731	3.9	4.5
Czechoslovakia	2,447	2,685	4.6	4.4
Iran	1,702	2,434	3.2	4.0
United States	1,174	2,320	2.2	3.8
People's Republic of China	2,164	2,240	4.1	3.7

Source: Anuarul Statistic al Repblicii Socialiste România 1977 (Annual Statistics of the Socialist Republic of Romania 1977), Bucharest. 1977, pp. 422–429.

The "most favored nation" status for trade agreements granted to Romania by the United States in 1975 was extended to 1976, thus continuing the favorable conditions for trade between the two countries. In 1976, trade with the United States soared to 2.3 billion lei, an increase of 98% over that of 1975, making the United States Romania's seventh largest trading partner.

Mineral trade statistics are presented in tables 2 and 3.

Table 2.—Romania: Exports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974 [1]	1975 [2]	Principal destinations, 1975
METALS			
Aluminum metal including alloys:			
Scrap	2,201	7,194	West Germany 4,434; Italy 1,555; France 726.
Unwrought	47,342	[3] 84,700	Japan 20,431; West Germany 6,444; Italy 4,918.
Semimanufactures	NA	11,253	Hungary 8,028; Poland 1,380; Japan 744; Yugoslavia 632.
Chromium oxide and hydroxide	60	10	All to France.
Copper metal including alloys, all forms	3,857	3,965	West Germany 3,799.
Iron and steel:			
Roasted pyrite	11,190	11,482	All to Austria.
Scrap	2,660	1,966	Spain 1,633; Italy 333.
Pig iron, ferroalloys, castings	36,448	128,341	Poland 40,636; Japan 40,244; Italy 38,085.
Steel, primary forms	16,635	157,577	Poland 77,004; Yugoslavia 37,712; Italy 19,873; Spain 16,914.

See footnotes at end of table.

Table 2.—Romania: Exports of selected mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974 [1]	1975 [2]	Principal destinations, 1975
METALS—Continued			
Iron and steel—Continued			
Semimanufactures:			
Bars, rods, angles, shapes, sections	230,000	70,918	Yugoslavia 50,369; Finland 10,055; West Germany 9,126.
Plates and sheets	664,000	227,054	West Germany 60,965; France 45,301; U.S.S.R. 43,277.
Hoop and strip	103,000	10,503	All to Yugoslavia.
Wire	59,000	25,537	Yugoslavia 21,118; West Germany 2,718.
Pipes, tubes, fittings	235,000	[3] 316,000	U.S.S.R. 209,894.
Unspecified	NA	668,988	U.S.S.R. 65,533; Poland 54,913.
Total	1,291,000	[3] 1,319,000	
Manganese ore	44,372	[3] 29,200	All to Japan.
Nickel scrap	75	197	France 100; Belgium-Luxembourg 60.
Silver:			
Unwrought or partly worked, not rolled ___value, thousands	NA	$6,108	All to Switzerland.
Waste and sweepings ___do___	$54	$1,293	West Germany $753; Italy $540.
Zinc metal including alloys, all forms	3,099	988	Norway 326; Switzerland 255; France 250.
NONMETALS			
Abrasives, grinding stone	NA	22	All to Italy.
Barite	6,391	626	All to France.
Boron oxides and acid	NA	88	Do.
Cement, hydraulic ___thousand tons	905	[3] 2,835	Yugoslavia 316; Czechoslovakia 133; Poland 73; Hungary 70.
Clay products, nonrefractory	91,561	15,094	Yugoslavia 13,833; Austria 1,184.
Diamond, industrial_value, thousands	$251	$1,266	All to Belgium-Luxembourg.
Fertilizer materials, manufactured:			
Nitrogenous	86,444	[3] 230,513	West Germany 93,530; France 72,936; Yugoslavia 38,079.
Phosphatic	1,615	25,495	Hungary 24,032.
Mixed	1,817	5,336	All to West Germany.
Gypsum, calcined	27,971	27,960	All to Hungary.
Lime, calcined	29,430	14,647	Do.
Salt	164,834	[3] 678,600	Hungary 304,875; Yugoslavia 79,425; West Germany 19,067.
Sodium and potassium compounds:			
Caustic soda	62,105	[3] 222,700	Hungary 74,543; U.S.S.R. 45,128.
Soda ash	179,151	[3] 350,500	Czechoslovakia 53,000; U.S.S.R. 44,087; Yugoslavia 29,327.
Stone, sand and gravel:			
Dimension stone, worked	25,789	20,789	West Germany 18,131; Austria 1,573.
Other	2,197	3,273	Poland 3,057; West Germany 216.
Unspecified	NA	154,135	All to Hungary.
Talc, natural, and steatite	953	1,006	All to West Germany.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	1,687	[3] 30,300	East Germany 8,000; Czechoslovakia 5,084; Hungary 2,913.
Gas, natural and manufactured million cubic feet	7,063	[3] 6,851	All to Hungary.
Peat and briquets	4,029	4,565	Austria 3,033; Italy 1,532.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	807	675	All to United States.
Refinery products:			
Gasoline ___do___	4,121	[3] 12,442	Netherlands 2,677; United States 1,386; West Germany 1,040; France 865.
Kerosine ___do___	30	[3] 34	Mainly to West Germany.
Distillate fuel oil ___do___	11,102	[3] 15,101	West Germany 2,403; France 1,134; Netherlands 1,044.
Residual fuel oil ___do___	12,274	[3] 15,038	United States 5,076; Sweden 3,314; Italy 2,668.
Lubricants ___do___	126	[3] 2,149	Hungary 48; Belgium-Luxembourg 43.
Other:			
Mineral jelly and wax do___	45	57	Yugoslavia 7; West Germany 5; Finland 4.
Petroleum coke ___do___	11	[3] 533	Greece 35; West Germany 16.
Unspecified ___do___	877	[3] 118	NA.
Total ___do___	28,586	45,472	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	8,723	55,952	Italy 24,240; West Germany 15,289; Yugoslavia 14,035.

NA Not available.

[1] Compiled from United Nations Supplement to the World Trade Annual, 1974. Walker and Co., New York, v. I, 1976.

[2] Unless otherwise specified, data were compiled from United Nations Supplement to the World Trade Annual, 1975. Walker and Co., New York, v. I (Eastern Europe and the Soviet Union), 1977. pp. 355–396; and official trade statistics of Czechoslovakia, East Germany, Hungary, Poland, and the U.S.S.R.

[3] Official trade statistics of Romania.

Table 3.—Romania: Imports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974 [1]	1975 [2]	Principal sources, 1975
METALS			
Aluminum:			
Bauxite	561,548	609,565	Greece 520,504; Yugoslavia 89,061.
Alumina	67,192	84,606	Greece 34,735; Italy 28,483; Hungary 16,035.
Metal including alloys, all forms	15,529	24,798	Hungary 20,294; West Germany 1,827; Belgium-Luxembourg 940.
Copper:			
Ore and concentrate	NA	847	All from Austria.
Metal including alloys, all forms	26,713	24,143	West Germany 5,858; U.S.S.R. 5,653; Poland 5,074.
Iron and steel:			
Iron ore and roasted pyrite thousand tons	10,002	[3] 10,873	U.S.S.R. 6,318; Spain 135.
Scrap do	663	--	
Pig iron, sponge iron, powder, shot do	554	[3] 583	U.S.S.R. 414; Japan 50; Yugoslavia 34.
Ferroalloys do	143	[3] 175	U.S.S.R. 92; Norway 13.
Steel, primary forms do	341	15	West Germany 8; Austria 4.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	590	433	U.S.S.R. 271; West Germany 46; Japan 35.
Plates and sheets do	297	198	West Germany 43; East Germany 27; Japan 26.
Hoop and strip do	54	82	West Germany 29; U.S.S.R. 23.
Rails and accessories do	72	70	Yugoslavia 43; Austria 14; U.S.S.R. 10.
Wire do	51	12	West Germany 8; Belgium-Luxembourg 1; Italy 1.
Pipes, tubes, fittings do	90	[3] 82	West Germany 34; Japan 15.
Unspecified do	--	775	Poland 191; Czechoslovakia 150; U.S.S.R. 136.
Total do	1,154	[3] 1,652	
Lead:			
Ore and concentrate	14,440	4,102	All from Poland.
Oxides	505	1,076	France 725; Austria 351.
Metal including alloys, all forms	820	4,244	Yugoslavia 3,700; West Germany 544.
Magnesium metal	NA	24	All from Austria.
Manganese oxide	849	493	All from Japan.
Mercury 76-pound flasks	--	2,030	All from Spain.
Molybdenum	NA	4	Japan 3; Austria 1.
Nickel metal including alloys, all forms	1,998	[4] 1,137	West Germany 311; Netherlands 308; Sweden 284.
Platinum-group metals, unwrought and semimanufactures value, thousands	$2,411	$1,761	United States $720; West Germany $476; United Kingdom $200.
Silver metal, unwrought and semimanufactures do	$310	$414	France $252; Switzerland $108.
Tin metal including alloys, all forms	748	187	Spain 165; West Germany 15.
Titanium oxides	8,013	1,246	West Germany 598; Japan 528.
Tungsten metal, all forms	4	14	France 8; Japan 4; Austria 2.
Zinc:			
Oxide and peroxide	2,216	2,030	All from Japan.
Powder (blue dust)	1,086	1,840	Belgium-Luxembourg 700; West Germany 675; Italy 465.
Metal including alloys, all forms	2,766	6,750	Yugoslavia 3,513; Italy 1,250; Poland 1,000.
Other:			
Ores and concentrates	NA	2,434	Netherlands 1,292; Japan 765.
Oxides, hydroxides, peroxides of metals, n.e.s	44	45	West Germany 41.
Metalloids	1,733	[4] 3,015	Yugoslavia 1,849; Norway 816.
Base metals including alloys, all forms	177	21	Belgium-Luxembourg 10.
NONMETALS			
Abrasives:			
Natural	301	[4] 108	All from Italy.
Manufactured	2,713	3,517	Austria 1,050; Italy 701; Yugoslavia 484.
Asbestos	28,521	41,299	U.S.S.R. 34,327; West Germany 2,740; Canada 2,441.
Barite and witherite	8,029	5,704	West Germany 2,786; France 1,960.

See footnotes at end of table.

Table 3.—Romania: Imports of selected mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974 [1]	1975 [2]	Principal sources, 1975
NONMETALS—Continued			
Cement, hydraulic	NA	126	All from France.
Chalk	700	1,528	France 968; United Kingdom 560.
Clays and clay products:			
Crude	15,501	31,586	Greece 11,665; Czechoslovakia 11,000; United Kingdom 6,541.
Products:			
Refractory	70,350	[4] 66,251	U.S.S.R. 23,282; Yugoslavia 20,533; Italy 7,457.
Nonrefractory	77	40	All from Italy.
Cryolite	1,011	NA	
Diamond:			
Gem, not set or strung value, thousands	NA	$1,459	All from United Kingdom.
Industrial do	$1,501	$2,534	Belgium-Luxembourg $2,462.
Diatomite and other infusorial earth	585	1,091	All from Iceland.
Feldspar and fluorspar	3,820	2,130	All from Italy.
Fertilizer materials:			
Crude, phosphatic: Apatite concentrate, gross weight	r 1,347,137	[3] 1,309,644	U.S.S.R. 559,681; United States 130,596.
Manufactured:			
Phosphatic	3,618	7,303	All from Israel.
Potassic, K_2O equivalent	64,700	[3] 91,900	East Germany 50,900; most of remainder from U.S.S.R.
Graphite	146	117	All from West Germany.
Magnesite:			
Crude	NA	2,994	Yugoslavia 1,995; Spain 999.
Products	40,430	45,439	Czechoslovakia 42,000; Hungary 3,339.
Mica, worked	38	16	France 12.
Pigments, mineral, iron oxides	924	428	West Germany 273; Hungary 155.
Pyrites, unroasted	21,000	123,320	All from Yugoslavia.
Stone, sand and gravel	266	1,880	Austria 1,551; Yugoslavia 291.
Sulfur:			
Elemental, including colloidal	64,972	115,954	Poland 114,000; West Germany 1,418; Yugoslavia 360.
Sulfuric acid	142,149	86,290	West Germany 35,755; United Kingdom 16,871; Poland 10,353.
Talc	380	205	All from Italy.
Other, crude	1,944	1,623	Netherlands 1,196; United Kingdom 427.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	521	2,187	West Germany 1,366; Italy 565.
Coal thousand tons	1,616	[3] 2,420	Czechoslovakia 804; U.S.S.R. 625; Poland 606.
Coke do	2,300	[3] 2,537	U.S.S.R. 999; Czechoslovakia 483; Italy 271.
Hydrogen, helium, rare gases	172	248	All from West Germany.
Petroleum:			
Crude thousand 42-gallon barrels	34,489	[3] 37,893	NA.
Refinery products:			
Distillate fuel oil do	52	1	All from Italy.
Lubricants do	14	[4] 12	Netherlands 6; Belgium-Luxembourg 2; West Germany 2.
Other do	166	144	West Germany 126.
Total do	232	157	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	21,410	13,172	Mainly from U.S.S.R.

r Revised. NA Not available.

[1] Compiled from United Nations Supplement to the World Trade Annual, 1974. Walker and Co., New York, v. I, 1976.

[2] Unless otherwise specified, data were compiled from United Nations Supplement to the World Trade Annual, 1975. Walker and Co., New York, v. I (Eastern Europe and the Soviet Union), 1977, pp. 355–396; and official trade statistics of Czechoslovakia, East Germany, Hungary, Poland, and the U.S.S.R.

[3] Official trade statistics of Romania.

[4] Partial figure; tonnage not available for all sources.

COMMODITY REVIEW

METALS

Aluminum.—Expansion of facilities continued at Romania's single aluminum plant, located at Slatina. In 1976, aluminum and aluminum alloy production was 207,000 tons; it is to reach 255,000 tons by 1980 according to the 5-year plan. In 1976, Romania exported 84,700 tons of aluminum metal and semimanufactures to Western Europe and Japan.

Total bauxite production in 1976 was an estimated 800,000 tons and is to increase to 1.5 million tons by 1980. Romania's bauxite is surface mined from an ore body near Dobreşti, in the general area of Oradea. Since indigenous production is insufficient to meet domestic demand, Romania imports additional bauxite from Yugoslavia and Greece.

Romania's two alumina plants, one located at Tulcea in the Danube Delta and the other near the Oradea bauxite mines, each have a capacity of 250,000 tons per year. Romania imports approximately 100,000 tons of alumina per year from Greece, Italy, and Hungary.

Copper.—In 1976, Romania's copper production amounted to 40,500 tons, an increase of 9.5% over that of 1975. Romania's annual imports amount to approximately 30,000 tons of copper metal including alloys, about one-third of which comes from the U.S.S.R.

Romania is planning to develop two surface mines in the Moldova Nouă and Roşia Poieni areas with a combined annual capacity of 20 million tons of low-grade copper ore (less than 0.3% copper metal content). When in full operation, these mines are to increase Romania's copper ore output 50%.[6]

Iron and Steel.—Romanian crude steel production in 1976 reached 10.7 million tons, an increase of 12.4% over that of 1975. Pig iron production was 7.4 million tons, a 12.3% increase over that of 1975. Steel semimanufactures output totaled 9.4 million tons in 1976. Iron ore production, however, decreased to 2.8 million tons from 3.1 million tons in 1975.

In 1976, Romania imported a total of 11.7 million tons of iron ore, of which 5.1 million tons came from the U.S.S.R. Pig iron imports for the same year were 560,600 tons; rolled steel products, 1.9 million tons; steel pipe, 101,000 tons; and ferroalloys, 223,300 tons. Exports of rolled steel products in 1976 amounted to 967,000 tons and steel pipe, 377,000 tons.

Romania's iron and steel industry is undertaking a major expansion and modernization program. By 1980, Romania is to produce 17 million to 18 million tons of crude steel per year and by 1990, 25 million to 27 million tons per year. These goals are to be achieved mainly by the expansion of the Galaţi integrated iron and steel works, whose 1976 annual capacity of approximately 6 million tons is to be increased to 10 million tons by 1980, and by the operation of the new steel complex being built at Călărasi on the Danube.

The Utas steelworks at Tîrgovişte was being developed as Romania's most important alloy plant. Contracts for equipment and technology have been signed with Soviet, West German, and Japanese firms. In 1976, a contract was signed between Romania's trade enterprise Metorom and West Germany's Vacmetal GmbH for the design, construction, and startup of a 110-ton vacuum degasing unit.

In the next 13 years, Romania's foundry industry is to undergo thorough expansion and modernization. The annual planned growth rate is about 14% through 1990. In 1975, Romania's total foundry production amounted to 1.4 million tons, consisting of 282,000 tons of drawn steel, 1.0 million tons of cast iron, and 65,000 tons of nonferrous castings. By 1980, total foundry output is to reach 2.3 million tons and by 1990, 4.4 million tons. In 1976, Romania operated 257 foundries, of which less than 10% have an annual capacity in excess of 20,000 tons and nearly 50% have an annual capacity below 2,000 tons. By 1980, Romania is to build 60 additional foundries, of which 27 are to have an annual capacity greater than 10,000 tons.

In 1976, Romanian Metallurgical Facilities Import-Export Corp. signed a contract with a Japanese firm, Hitachi Kinzoku, for production technology to be used in a high-grade special steel bar plant that is to be part of an integrated steel plant being built by the Romanian Government. The plant, which is to have an annual capacity of

[6] Scînteia (Bucharest). Jan. 8, 1977.

10,000 tons of cold-finished steel bars, will cost about 10 billion yen and is to start operating in spring of 1978.[7]

Lead and Zinc.—In 1976, Romania's lead and zinc production reached 42,465 tons and 53,373 tons, respectively. Lead and zinc in Romania are associated with copper in complex sulfide ores and come mainly from the Baia-Mare mining complex, Bălan, and other smaller mines. The Copsa Mică smelting plant reduces most of the sintered concentrates and has an estimated annual capacity of 35,000 tons of lead and 60,000 tons of zinc.

Titanium and Zirconium.—Romania was planning to start developing the Black Sea coastal alluvial sand deposits, which contain titanium and zirconium, in 1977.

NONMETALS

Cement.—Total cement production in 1976 was 12.5 million tons, an 8.9% increase over that of 1975. By 1980, Romania is planning to reach an annual production of 19 million to 20 million tons. In 1976, Romania exported a total of 2.7 million tons, compared with 2.8 million tons exported in 1975.

During 1976, construction continued on Romania's largest and most technologically advanced cement plant, which is to produce high-quality cement employing the dry method. Construction on the plant, located in Taşca in Neamţ County, began in 1975. The first production line is to go into operation in 1977; the second line is to be commissioned by the end of 1978.

Fertilizer Materials.—In 1976, Romania continued to encourage the growth of its fertilizer industry and produced a total of 1.87 million tons of mineral fertilizers, of which 1.3 million tons was nitrogenous and 493,000 tons was phosphatic. Romania has no potassic or phosphatic raw materials and therefore relies exclusively on imports of these commodities. In 1976, Romania imported a total of 2.0 million tons of phosphate rock and apatite concentrates, of which 693,000 tons came from Morocco and 560,000 tons came from the U.S.S.R. Imports of potassic fertilizers totaled 109,500 tons.

Romania's exports of nitrogenous fertilizers have shown a dramatic increase in the past few years. In 1976, exports totaled 1.93 million tons, an increase of 36.5% over those of 1975. The bulk of these exports go to West Germany and France.

Romania has been constructing four identical compound fertilizer plants, each with an annual capacity of 891,000 tons. These plants are located at Tîrgu Mures, Craiova, Turnu Măgurele, and Arad. The plant at Tîrgu Mureş went into operation in October 1975 and that at Craiova in March 1976; the Turnu Măgurele plant is to be completed in March 1977; and the plant at Arad is to be commissioned by the end of 1977.[8] Each of the plants incorporates production lines that manufacture nitrogen-phosphorus-potassium fertilizer in the ratio of 2:1:1 and nitrogen-phosphorus fertilizer in the ratio of 2:1.[9]

The basic design for the Tîrgu Mureş plant was provided by Davy Powergas Ltd., based on the Norsk Hydro A/S process. The remaining three plants were built according to the Powergas design by Iprochim (the Romanian State engineering enterprise).

During 1976, work proceeded on the new nitrogen and compound fertilizer plant located at Bacău. The new complex is scheduled to be completed in 1978 and will include a 891,000-ton-per-year complex fertilizer plant, a 420,000-ton-per-year urea plant, a 300,000-ton-per-year ammonia plant, and a 480,000-ton-per-year nitric acid plant.

Lime.—Production of lime in 1976 reached 3.3 million tons, an increase of 8.4% over that of 1975. Production of lime is to double at the Bicaz binders and asbestos cement combine because a new kiln started operating there in late 1975.

Salt.—Romania has a large and well established salt mining industry, with total salt production of 4.2 million tons in 1976, 9.8% over that of 1975. Since 1970, Romania has been exporting over 600,000 tons of salt per year (with the exception of 1974, when exports dropped to 164,834 tons). In 1976, total exports reached 667,500 tons.

Romania's total salt reserves are estimated to exceed 20 billion tons and consist almost entirely of rock salt found mainly in salt domes. The salt is of good quality with a 98% to 99% NaCl content. About 48%

[7] Nikkon Kogyo Shinbun (Tokyo). Nov. 26, 1976, p. 7.
[8] Phosphorus and Potassium (London). No. 88, March-April 1977.
[9] Nitrogen (London). No. 102, July-August 1976, pp. 13–14.

of this salt is mined underground, using room-and-pillar methods, and 52% of the output is obtained from wells as brine.

Sulfur.—Romania is planning to mine its sulfur reserves, estimated to be among the largest in Europe, in the Calimiani Mountains of Transylvania. By 1980, 80% of the country's domestic consumption is to be supplied by the planned development. In 1975, Romania imported 114,000 tons of sulfur from Poland. Romania's sulfuric acid production in 1976 was 1.56 million tons, an increase of 7.4% over that of 1975.

MINERAL FUELS

In 1976, total primary energy consumption in Romania reached an estimated 89.9 million tons standard coal equivalent (SCE), an increase of 7.9% over that of 1975. Natural gas provided 54% of the total, oil 25%, coal 20%, and hydroelectrical power 1%. Production of primary energy derived from fossil fuels and hydroelectrical generation increased from 81.1 million tons SCE in 1975 to 84.6 million tons SCE in 1976.

Romania encouraged the use of coal, especially lignite, for the generation of electrical power to save hydrocarbons for the petrochemical industry. Total marketable coal production, which increased from 20.5 million tons in 1970 to 25.8 million tons in 1976, is to reach 56 million tons by 1980 and about 75 million tons by 1990. Production of lignite is to increase from 18.2 million tons in 1976 to 47 million tons in 1980 and 62 million tons in 1990.

During the current 5-year plan period, Romania expects to increase crude oil and natural gas reserves by extending deep drilling and oil recovery and prospecting on the Black Sea continental shelf. Approximately 2 million tons of oil reserves is expected to result from these activities, increasing annual crude oil production from 14.7 million tons in 1976 to 15.5 million tons in 1980. The first offshore drilling rig was put into operation during 1976, and a second rig is in the planning stage.

In 1976, Romania produced a total of 58.3 billion kilowatt-hours of electrical energy, an increase of 8.6% over that of 1975. Of this production, 8.1 billion kilowatt-hours (14%) was produced by hydroelectric powerplants and the rest by conventional thermal powerplants. During the 1976–80 period, Romania plans to install 7,200 megawatts of electrical power capacity, of which 59.2% is to be generated by coal-fired thermoelectric plants, 13.0% by oil-fired thermoelectric plants, 24.4% by hydroelectric plants, and 3.4% by thermoelectric plants using other fuels.[10]

The first nuclear powerplant is still in the planning stage and is to go into operation around 1985 with a 440-megawatt capacity.

[10] Romanian Foreign Trade (Bucharest). No. 102, January 1977, pp. 36–37.

Table 4.—Romania: Total primary energy balances, 1975 and 1976 [1]

(Million tons of standard coal equivalent [2])

Year	Total primary energy	Coal (lignite, anthracite, bituminous) and coke	Crude oil and petroleum products	Natural and associated gas	Hydroelectrical power
1975:					
Production	81.1	14.3	21.4	44.3	1.1
Imports	12.0	4.1	7.5	--	.4
Exports	9.8	--	9.1	.3	.4
Apparent consumption	83.3	18.4	19.8	44.0	1.1
1976:					
Production	84.6	13.7	21.6	48.3	1.0
Imports	17.4	4.5	12.5	--	.4
Exports	12.1	--	11.5	.3	.3
Apparent consumption	89.9	18.2	22.6	48.0	1.1

[1] Production and trade data were taken from the Statistical Yearbook of the Socialist Republic of Romania (Bucharest), 1977.

[2] 1 ton standard coal equivalent (SCE)=7,000,000 kilocalories. Conversion factors used are as follows: Hard coal, 1.0; lignite and brown coal, 0.33; crude oil, 1.47; natural gas, 1.33 (per thousand cubic meters); and hydroelectrical power, 0.125 (per thousand kilowatt-hours); factors were derived from: United Nations. World Energy Supplies, Statistical Papers, ser. J, No. 18, New York, 1975.

Coal.—Romania's total run-of-mine coal production in 1976 was 28.1 million tons, a 4% decrease from that of 1975. Production of marketable coal was 25.8 million tons, of which 1.9 million tons was for coke and semicoke production and 18.2 million tons was lignite.

Romania's metallurgical coal and coke requirements are supplied equally by domestic resources and imports. In 1976, Romania imported a total of 2.6 million tons of bituminous coal and 2.8 million tons of coke.

In order to insure adequate supplies of crude oil and natural gas for petrochemical feedstocks, Romania is launching a drive to increase the production of indigenous lignite to be used for electrical power generation. Production of lignite is to increase from 18.2 million tons in 1976 to 62 million tons by 1990. Romania's lignite deposits are mostly located south of the Carpathian Mountains in the area of Tîrgu Jiu, with some smaller deposits near Braşov. These deposits are divided into seven basins, of which only the Rovinari, Motru, and Jilt Basins have deposits suitable for strip mining. Eleven surface mines were operating in these three basins in 1976.

The ash content of the lignite is between 34% and 40%, and the moisture content is 39% to 45%. The calorific value is 2,000 to 2,200 kilocalories per kilogram (3,600 to 4,000 Btu per pound), but the effective value is decreased to 1,600 to 1,850 kilocalories per kilogram (2,900 to 3,450 Btu per pound) by the inclusion of refuse associated with the mining.

Romania signed an agreement with a private U.S. mining company for the joint development of a coal mine now under construction in Buchanan County, Va. Under the agreement, Romania is to pay an initial advance of $53 million toward the construction of the mine. Romania is to buy 14 million tons of coal at cost and has the option to purchase an additional 13.3 million tons at prevailing market prices over the next 30 to 40 years. The U.S. firm is to supply Romania with up to 27.3 million tons of high-grade metallurgical coal valued at about $2 billion. Development of the mine is to be completed in 4 years, with the first coal delivery to Romania scheduled for 1980. The mine is expected to have a total output of between 40 million and 50 million tons.[11]

The first phase of the agreement between Romania and West Germany's Krupp Industrie- und Stahlbau was completed near yearend. The agreement called for the joint construction of 14 bucket excavators and corresponding stackers. The construction was to take place in three stages. The first stage comprised four excavators and three stackers; the second stage, to be completed in 1979, included five excavators and three stackers.[12]

The bucket-wheel excavators are 132 meters long and 35 meters high, have a wheel diameter of 11.5 meters, and have a capacity of 1,800 cubic meters per hour. The stackers are 150 meters long and 37 meters high and have a capacity of 6,500 cubic meters (10,400 tons) per hour of overburden removal.[13] The machines built in the first and second stages will be used in the Rovinari Basin.

Natural Gas.—Romania's gross production of natural gas in 1976 reached 36.1 billion cubic meters, an 8.5% increase over that of 1975. Nonassociated gas production made up 29.8 billion cubic meters of this. Gross production of natural gas, however, is expected to decline to 26.8 billion cubic meters by 1980.

Romania was self-sufficient in gas in 1976 and has substantial reserves (approximately 220 billion cubic meters) centered in the Transylvanian Basin around Tîrgu Mureş. Romania planned to import some gas from the U.S.S.R., however, to conserve indigenous reserves of natural gas for use as feedstock for the fertilizer industry.

Romania is participating with other CMEA countries in the construction of the Orenburg natural gas pipeline, which links the large condensate deposits of the Orenburg region with the western border of the U.S.S.R. at Uzhgorod. The pipeline, whose construction began in 1975, is 2,750 kilometers long and will allow the participating countries to receive up to 15.5 billion cubic meters of Soviet natural gas annually. Romania is responsible for financing equipment and materials from Western countries and for purchasing and constructing gas-

[11] Journal of Commerce (New York). June 14, 1977, p. 8.
Wall Street Journal (New York). May 31, 1977, p. 5.
[12] Glückauf (Essen). V. 113, No. 7, Apr. 7, 1977, p. 348.
[13] Braunkohle (Düsseldorf). V. 1–2, January-February 1977, p. 44.

drying and sulfur-removal installations within the Orenburg complex. Upon completion of the pipeline in late 1978, Romania is to receive 1.5 billion cubic meters of Soviet natural gas.[14]

A gas pipeline connecting the Romanian gasfields to eastern Hungary has been operating for almost 20 years, with an annual export of 200 million cubic meters of Romanian natural gas. Other pipelines from the U.S.S.R. cross sections of Romanian territory to deliver Soviet gas to Bulgaria and Hungary.

Nuclear Energy.—Romania's nuclear power program has been delayed, and the first nuclear powerplant is now scheduled to go into operation in 1981. Approximately 20% of Romania's electrical power is to be generated by nuclear powerplants by 1990, but this goal appears to be overly optimistic because of the reported delay in the nuclear power program.

Petroleum.—Romanian crude oil production leveled off at 14.7 million tons in 1976, an increase of less than 1% over that of 1975. Since 1972, the Romanian Government has limited crude oil production growth to 1% per year to slow the depletion of oil reserves. Imports of crude oil have more than doubled since 1973, reaching 8.5 million tons in 1976, an increase of 67% over those of 1975. Crude oil is imported from Saudi Arabia, Iran, Iraq, Libya, Algeria, Venezuela, and the People's Republic of China. Romania remains the only CMEA country that did not import crude oil from the U.S.S.R. in 1976.

Romania's oil-refining capacity was 24 million to 25 million tons per year. Eleven refineries operated at nearly full capacity, processing indigenous crude oil and large crude oil imports from the Middle East. Romania's current policy is to produce a large surplus of petroleum products for export to some 50 foreign countries. In 1976, total exports of petroleum products amounted to 7.8 million tons, an increase of 27% over those of 1975.

Romania's oil deposits are located in three regions, of which the oldest and most productive is the area around Ploieşti, Piteşti, Tîrgovişte, and Telejean in the Prahova Valley. The second most productive area is the Bacău region on the Moldavian slopes of the Carpathian Mountains. The third is located in West Carpathia, southeast of the Carpathian range. In 1974, Romania had about 7,000 oil wells and 250 drilling rigs in operation. Proved crude oil reserves were about 100 million tons in 1971.

Romania's first offshore drilling rig, *Gloria,* was put into operation in September 1976 some 130 kilometers off the coast near the port of Constanţa in the Black Sea. It was launched by the Galaţi shipyard in October 1975 and was towed down the Danube River to the Black Sea in May 1976. A special pier was built at Constanţa to serve as the base for Romania's offshore drilling.[15] Exploration performed by the rig revealed the presence of oil and confirmed that the large onshore fields around Ploieşti extend under the Black Sea. Romania is planning to build a second drilling rig to establish the size of the oilfields. Romania will also be involved in a joint effort with Bulgaria in exploratory drilling off Bulgaria's coast in the Black Sea.

Negotiations continued during 1976 between Romania and Kuwait on the joint $1 billion refinery and petrochemical complex to be constructed on the Black Sea between Navodari and Cape Midia, north of Constanţa. This large complex, which is one of Romania's major investments during the current 5-year plan, is to process 8 million tons of Kuwaiti crude oil per year and produce 17 petroleum products, with special emphasis on premium gasolines. The annual production of the refinery is to include 3 million tons of fuel oil, 1.7 million tons of premium-grade gasoline, 900,000 tons of diesel oil, 300,000 tons of jet fuel, 100,000 tons of butane, and 80,000 tons of propane.

A special port facility will be incorporated into the complex to handle the imported oil. The startup of the complex is to be between 1982 and 1984. Romania is to control 51% of the venture and Kuwait 49%.

Construction of the joint industrial complex in the towns of Giurgiu, Romania, and Ruse, Bulgaria, which are located on opposite banks of the Danube River, began in December 1976. The complex is to produce a large variety of complete installa-

[14] Romanian Foreign Trade (Bucharest). No. 3, March 1976, p. 12.
[15] Scînteia (Bucharest). Sept. 17, 1976.
Romanian Foreign Trade (Bucharest). No. 103, February 1977, p. 2.

tions and equipment (especially shallow- and medium-depth drilling equipment) for the petrochemical, mining, and metallurgical industries. By the end of the current 5-year plan, the complex is to function at full capacity and employ about 10,000 workers.[16]

[16] Scînteia (Bucharest). Dec. 11, 1976.

The Mineral Industry of Saudi Arabia

By Candice Stevens [1]

In 1976, the petroleum industry accounted for 95% of Government revenues, virtually all export earnings, and 75% of Saudi Arabia's gross domestic product (GDP), estimated at $49 billion.[2] In December 1976, Saudi Arabia introduced a two-tier pricing system to the Organization of Petroleum Exporting Countries (OPEC) when it raised its crude oil prices 5% while other OPEC members opted for a 10% increase.

Oil revenues were expected to finance the major part of Saudi Arabia's second 5-year development plan (1975–79), which scheduled expenditures of $142 billion. Two complete industrial cities, whose construction was to be carried out over the next 11 years, were to be based on hydrocarbon-processing industries using oil and natural gas. At Yanbu, located on the Red Sea coast north of Jidda, crude oil and natural gas liquids (NGL) were to be delivered by transpeninsular pipelines to new refining centers. Projects at Yanbu included a petrochemical complex, an NGL plant, and a major crude oil refinery and export terminal. The second industrial center was to be located at Jubail on the east coast, 80 kilometers north of Dhahran. Projects at Jubail included an iron and steel complex, an aluminum smelter, several petrochemical facilities, and an oil refinery. Saudi Arabia also embarked on an extensive gas-gathering project on the east coast to produce basic feedstocks and energy.

Several Government organizations were established to supervise the various development projects. The Royal Commission for Jubail and Yanbu was entrusted with coordinating plans and awarding contracts for the two industrial centers. The Saudi Arabian Basic Industries Corp. (SABIC) was established to hold and implement the Government share of industrial joint ventures. The responsibility for petroleum, gas, and mineral projects was transferred from the General Petroleum and Mineral Organization (Petromin) to the Ministry of Industry and Electricity. Petromin continued to be responsible for refining, marketing, distributing, and transporting petroleum internally and abroad.

PRODUCTION

In 1976, Saudi Arabia became the second largest oil producer in the world, following the U.S.S.R. The Arabian American Oil Co. (Aramco), which produced all Saudi oil except the output shared by Saudi Arabia and Kuwait in the partitioned Kuwait-Saudi Arabia Neutral Zone, became the first oil company to produce more than 3 billion barrels in 1 year. Aramco's production increased 23.5% from 6.8 million barrels per day in 1975 to over 8.4 million barrels per day in 1976. The 1976 output brought Aramco's cumulative production to more than 27.4 bil-

[1] Economist, International Data and Analysis.
[2] Where necessary, values have been converted from Saudi riyals (SRls) to U.S. dollars at the rate of SRls3.53=US$1.00.

lion barrels. In the partitioned Neutral Zone, the Arabian Oil Co., Ltd. (Japan) (AOC) produced 152,000 barrels per day and the Getty Oil Company (GOC) produced 82,000 barrels per day in 1976. Saudi Arabia's proven oil reserves were set at 110 billion barrels at yearend 1976.

Saudi Arabia produced approximately 500,000 barrels per day of refined petroleum products and 185,000 barrels per day of NGL in 1976. Cement production totaled 1.2 million tons. Other mineral products included steel and aluminum semimanufactures and small quantities of nonmetals. Saudi Arabia's mineral production in 1976 is given in table 1.

Table 1.—Saudi Arabia: Production of mineral commodities [1]

Commodity	1974	1975	1976 p
METALS			
Steel semimanufactures, hot-rolled ---metric tons--	e 14,000	e 14,000	NA
NONMETALS			
Cement, hydraulic [2] ---thousand metric tons--	r 964	1,020	e 1,200
Gypsum ---do---	17	e 17	e 17
Lime e ---do---	15	15	15
Sulfur e ---do---	r 3	r 3	3
MINERAL FUELS AND RELATED MATERIALS			
Gas, natural:			
Gross production ---million cubic feet--	1,670,729	1,335,312	1,661,568
Marketed production e ---do---	219,000	200,000	240,000
Natural gas liquids:			
Propane and butane ---thousand 42-gallon barrels--	r 37,800	39,400	67,628
Natural gasoline and other ---do---	r 11,700	11,300	
Total ---do---	r 49,500	50,700	67,628
Petroleum:			
Crude ---do---	r 3,095,640	2,582,549	3,139,721
Refinery products:			
Gasoline ---do---	43,813	8,420	9,545
Jet fuel ---do---	7,827	3,589	4,338
Kerosine ---do---	7,431	8,832	8,333
Distillate fuel oil ---do---	27,669	24,838	26,655
Residual fuel oil ---do---	98,787	78,723	97,200
Other:			
Liquefied petroleum gas ---do---	37,939	1,839	102,202
Naphtha ---do---	1,743	22,031	
Asphalt ---do---	1,949	2,469	
Unspecified ---do---	53		
Refinery fuel and losses ---do---	7,194	7,055	9,085
Total ---do---	234,405	157,796	257,358

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Includes Saudi Arabia's one-half share of crude oil and natural gas production in the former Kuwait-Saudi Arabia Neutral Zone, and its share of refinery output by its concessionaires in that area.

[2] Data presented are for Hejra calendar years, which correspond closely to Gregorian calendar years.

TRADE

Aramco exported approximately 8 million barrels per day of crude oil in 1976. Many of Saudi Arabia's direct sales contracts with other countries expired at the end of 1975, and it was decided in 1976 to extend these contracts 3 more years with volumes and terms unchanged. Buyers were required to lift at least two grades of crude oil, with no more than 75% being Arabian Light crude oil. The United States was Saudi Arabia's largest overall supplier in 1976, accounting for 18% of total imports at a value of $1.6 billion.

Owing to severe congestion at the country's ports, Saudi Arabia initiated a crash construction program to expand handling capacity. Jidda and Dammam, which handled over 90% of total imports, were unable to cope with the upsurge in imports, which more than tripled in value since 1973. The capacity of both ports was to be increased by 1980, and three

additional ports were to be constructed. The consortium of Skanska Cementgjuteriet AB (Sweden), Grands Travaux de Marseille (France), and Archirodon Construction Co. (Greece) was to dredge the harbor at Jidda and add two new piers. The consortium of Interbeton BV (the Netherlands), Philipp Holzmann AG (West Germany) and Archirodon was to increase capacity at Dammam from 1.7 million tons to 7 million tons per year.

Sir William Halcrow and Partners (United Kingdom) was the consulting engineer, and a consortium of private Saudi firms and Archirodon was to undertake the construction of a deepwater port at the new industrial center of Yanbu. The Republic of Korean firm Hyundai International Inc. was contracted to construct facilities at Jubail including an open-sea tanker terminal for handling tankers of 500,000 deadweight tons. Santa Fe International Inc. (United States) was to design and construct a new port at Ras Misha'ab near the Kuwait border.

Aramco also planned an expansion of its terminal at Ju'aymah, which had a loading capacity of 3 million barrels per day. A liquefied petroleum gas (LPG) loading facility was to be constructed at Ju'aymah by National Supply Co. (UK) Ltd. (United Kingdom). Aramco operated two other terminals on the Persian Gulf: The Ras Tanura terminal, rated as the world's largest offshore facility with an export capacity of 8 million barrels per day, and a small deepwater terminal serving the Marjan and Zuluf oilfields.

Several tanker companies were formed in Saudi Arabia during the past few years to take advantage of the new law giving preferential right for transport of Saudi oil to Saudi companies. During 1976, the number of tankers registered in Saudi Arabia increased from 7 to 14, totaling 1.3 million deadweight tons. Companies included the Saudi Maritime Co. (SAMARCO), a joint venture of Mobil Oil Corp. and private Saudi interests; the Saudinaft Tanker Co., a joint venture that included Shell Oil Co.; and the Saudi Arabian Shipping Co., a joint venture that included Mitsui O.S.K. Lines Ltd. of Japan.

Table 2.—Saudi Arabia: Exports of crude petroleum and petroleum refinery products [1]

(Thousand 42-gallon barrels)

Commodity	1974	1975	1976
Crude petroleum	2,897,924	2,314,945	2,868,234
Petroleum refinery products: [2]			
Shipments other than bunkers:			
Gasoline	36,680	32,551	[3] 46,438
Jet fuel	2,067	3,141	3,653
Kerosine	2,395	3,451	1,490
Distillate fuel oil	12,842	11,086	4,805
Residual fuel oil	18,388	26,410	12,720
Other	38,577	40,061	45,213
Total	110,949	116,700	114,319
Bunkers:			
Jet fuel	--	--	3,353
Distillate fuel oil	1,279	1,262	1,457
Residual fuel oil	76,997	46,137	53,915
Total	78,276	47,399	58,725

[1] Includes Saudi Arabia's share of exports from the former Kuwait-Saudi Arabia Neutral Zone.
[2] Excludes exports (if any) by Petromin.
[3] Includes naphtha.

Table 3.—Saudi Arabia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976
METALS			
Aluminum:			
Oxide and hydroxide	3	1	11
Metal including alloys, all forms	5,437	6,568	10,898
Arsenic trioxide, pentoxide, acid	6	61	28
Copper metal including alloys, all forms	1,278	2,410	1,097
Iron and steel:			
Scrap	724	433	277
Pig iron, ferroalloys, similar materials	5,842	3,628	8,363
Steel, primary forms [1]	13,060	11,599	11,036
Semimanufactures:			
Bars, rods, angles, shapes, sections	228,307	199,718	597,858
Plates and sheets	33,968	47,799	93,957
Hoop and strip	469	2,017	5,348
Rails and accessories	807	757	3,171
Wire	2,226	3,798	10,518
Tubes, pipes, fittings [2]	75,417	78,085	149,911
Castings and forgings	270	10,135	27,306
Lead:			
Oxides	33	143	59
Metal including alloys, all forms	516	885	1,999
Magnesium metal including alloys, all forms	38	1	78
Manganese oxides	26	8	2
Molybdenum metal including alloys, all forms	50	50	4
Nickel metal including alloys, all forms	189	119	2,705
Platinum-group metals and silver metal, including alloys:			
Platinum group troy ounces	641,085	847,813	765,443
Silver do	27,039	788,238	1,667,237
Tin metal including alloys, all forms	284	158	298
Titanium oxides	245	609	225
Tungsten metal including alloys, all forms	9	23	207
Zinc:			
Oxides	196	124	148
Metal including alloys, all forms	421	1,451	3,631
Other:			
Ores and concentrates, n.e.s	69	200	628
Oxides, hydroxides, peroxides of metals, n.e.s	2	50	21
Metals including alloys, all forms:			
Alkali, alkaline earth, rare-earth metals	738	234	1,267
Pyrophoric alloys	30	45	29
NONMETALS			
Abrasives:			
Pumice, emery, natural corundum	478	102	304
Grinding and polishing wheels and stones	295	376	650
Asbestos	11,757	10,405	11,222
Barite and witherite	1,971	2,603	30,385
Boron materials:			
Crude natural borates	16	16	--
Oxide and acid	(3)	6	1
Cement	634,678	645,792	1,870,889
Chalk	1,622	766	2,355
Clays and clay products:			
Crude clays	16,745	5,725	14,353
Products, refractory and nonrefractory	4,340	29,156	65,246
Diatomite and other infusorial earth	3,138	22,418	3,773
Feldspar and fluorspar	(3)	--	--
Fertilizer materials:			
Crude:			
Nitrogenous	7,809	3,181	2,157
Phosphatic	239	97	859
Potassic	3	--	517
Other	354	446	275
Manufactured:			
Phosphatic	4,854	712	4,291
Potassic	262	23	1,245
Mixed	157	5,013	439
Ammonia	675	173	290
Graphite	1	17	90
Gypsum and plasters	366	85	995
Lime	26,648	16,380	47,331
Magnesite	82	4	13
Mica:			
Crude	103	1,039	189
Worked, including agglomerated splittings	6	15	17
Pigments, mineral, including processed iron oxides	1,376	1,783	1,126
Pyrite, gross weight	598	686	105

See footnotes at end of table.

Table 3.—Saudi Arabia: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity		1974	1975	1976
NONMETALS—Continued				
Salt and brine		2,766	1,784	4,266
Sodium and potassium compounds		2,705	3,387	3,314
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked:				
Calcareous		3,862	6,229	7,582
Slate		58	50	(3)
Other		1,428	640	1,405
Worked:				
Slate		265	840	4,535
Paving and flagstone		1,198	4,423	33,492
Other		2,910	5,871	11,210
Dolomite		51	463	46
Gravel and crushed rock		5,899	8,492	23,100
Sand, excluding metal bearing		298	1,828	833
Other		18	292	595
Sulfur:				
Elemental, all forms		1,067	381	20
Sulfur dioxide		91	10	37
Sulfuric acid		27	22	66
Other nonmetals, n.e.s.:				
Crude		25	--	--
Slag, dross, similar waste, not metal bearing:				
From iron and steel manufacture		144	1	3
Slag and ash, n.e.s		50	8	300
Oxides and hydroxides of magnesium, strontium, barium		42	1,739	154
MINERAL FUELS AND RELATED MATERIALS				
Asphalt and bitumen, natural		2,543	1,164	929
Carbon black and gas carbon		4	24	33
Coal and coke, including briquets		691	759	1,273
Hydrogen, helium, rare gases		91	181	15
Petroleum:				
Crude and partly refined	thousand 42-gallon barrels	r 14	8	10
Refinery products:				
Gasoline	do	10	(3)	1
Kerosine and jet fuel	do	(3)	1	2
Distillate fuel oil	do	58	14	6
Residual fuel oil	do	8	3	18
Lubricants	do	271	243	427
Other	do	49	46	54
Total	do	396	307	508
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		1,642	1,430	1,156

r Revised.
1 May include some unspecified semimanufactures.
2 Includes blanks for pipes and tubes.
3 Less than ½ unit.

COMMODITY REVIEW

METALS

Saudi Arabia allocated $189 million of its expenditures under the current 5-year plan to exploration for nonpetroleum minerals. The Directorate General of Mineral Resources (DGMR) granted several large-scale mineral exploration concessions in 1976. The agreements included exclusive rights to obtain mining leases for a 30-year period, with the Government retaining the option of acquiring a 50% interest in any venture. The Saudi mining code also provided for an initial tax holiday of 5 years on any mine and guaranteed the repatriation of capital and profits.

The DGMR was to continue geological mapping of the country. The first stage of the survey focused on the search for base metals in older rocks of the Arabian Shield in the western part of Saudi Arabia. Further studies were to concentrate on younger rocks to the north and east of the Arabian Shield where copper, phosphate, and uranium were to be the main targets.

The Arabian Shield Development Co. continued its study of the Wadi Qatan

nickel deposit and the Al Masani zinc-copper deposit, both in Asir Province. Noranda Mines Ltd. (Canada) was granted a license for general exploration of the minerals of the Arabian Shield. Rio Tinto Finance & Exploration Ltd. (Riofinex), a subsidiary of Rio Tinto-Zinc Corp. Ltd., received a contract for geological work that would be complementary to existing surveys being carried out by the U.S. Geological Survey (USGS) and the Bureau de Recherches Géologiques et Minières (BRGM) (France).

The Saudi-Sudanese Commission for the Exploitation of Red Sea Resources, established in 1974, awarded exploration contracts in 1976 for copper, lead, zinc, and silver nodules in the Red Sea. The Arabian Geophysical & Surveying Co. (ARGAS) was to undertake a $5 million study of oceanographic and environmental conditions of the Red Sea. The BRGM was to act as consultant to the study, which was scheduled to begin in spring 1977. Preussag A.G. (West Germany) was to subsequently begin feasibility studies on mineral exploitation. The first phase of the survey was to last 2 years and cost $9 million.

Aluminum.—Saudi Arabia's 5-year plan called for the construction of a 200,000-ton-per-year aluminum smelter. Design work for the smelter, to be located at Jubail, was postponed in 1976 owing to delays encountered in the natural gas gathering and utilization project. A number of small plants, having a combined capacity of 37,000 tons per year, manufactured a variety of aluminum products from imported aluminum.

Copper.—BRGM geologists continued their feasibility investigation of reopening the ancient copper mines at Um al-Dammar, 165 kilometers southeast of Medina. This study was part of an overall survey of the copper resources of the Jabal Sayid area undertaken by the Société d'Études de Recherches et d'Explorations Minières (SEREM) and United States Steel Corporation in 1974. Previous drilling by the Government at Jabal Sayid, 320 kilometers northeast of Jidda, revealed reserves estimated at 8 million tons.

Gold.—Gold Fields Mahd Adh Dhahab Ltd. (GFMAD), a consolidated Gold Fields Group subsidiary, concluded an exploration agreement with Petromin in 1976. The company was to prospect for gold on a 1,600-square-kilometer tract around Mahd adh Dhahab, 300 kilometers northeast of Jidda. A 4-year geological, geochemical, and geophysical investigation of this district was completed in 1975 by the USGS. Ore bodies at Mahd adh Dhahab were mined from 1939 to 1954 by the Saudi Arabian Mining Syndicate, Ltd., yielding a total of 766,000 troy ounces of gold and more than 1 million troy ounces of silver. Previous surveys indicated that the mining district still contained workable deposits of gold, silver, and other metals.

Iron and Steel.—Three principal iron ore deposits have been identified in Saudi Arabia. Wadi Sawawin, 20 kilometers inland from the Gulf of 'Aqaba, is a hematite deposit estimated to contain 40% iron. The largest deposit, Wadi Fatimah, is located 40 kilometers south of Jidda; it was estimated to contain 50 million tons of hematite reserves averaging 45% iron. Reserves at Jebel Idsas, a magnetite deposit in central Saudi Arabia, were reported at 6 million tons containing 69% iron. In 1976, Saudi Arabia concluded a contract valued at $15 million with British Steel Corp. for the evaluation of the Wadi Sawawin deposits. The 4-year study was to involve 3,000 meters of core drilling in 20 holes during the initial phase of testing. Previous studies of Saudi Arabia's iron ore deposits indicated that their small size, low grade, and isolated location would restrict commercial exploitation.

In 1976, an agreement was signed with Korf Stahl AG (West Germany) for the establishment of a major steel complex at Jubail. This contract replaced previous plans for the erection of a steel pellet plant at Jubail using iron ore imported from Brazil. The new agreement provided for an 800,000-ton-per-year Midrex direct reduction steel mill costing $100 million to $300 million. SABIC was to hold a majority interest in the venture and to make remaining shares available to private Saudi investors.

The Jidda steel-rolling mill was to be expanded from 45,000 tons to 250,000 tons per year. SABIC signed a letter of intent in 1976 with Broken Hill Pty. Co. Ltd. (Australia) for the expansion project. The Jidda plant, opened in 1967, produced reinforcing wires and rods, plates, angles, and other simple steel products from imported billets.

Guest Keen & Nettlefolds Ltd. (United Kingdom) was to participate in the establishment of a factory to produce 20,000 tons per year of steel-reinforcement fabric. The $8.7 million venture was to be owned 40% by the firm and 60% by private Saudi interests. The plant, which is located at Dammam on the Persian Gulf, was scheduled to begin production in 1978.

NONMETALS

Barite.—A barite grinding plant to produce oil well drilling-mud additives was to be constructed at Dammam by Dresser Industries Inc. Barite deposits in Saudi Arabia were located at Rabigh, 120 kilometers north of Jidda, and near Sanam, southwest of Riyadh.

Cement.—In 1976, Saudi Arabia produced approximately 1.2 million tons of cement from three plants. Cement consumption was expected to increase to 9 million tons per year by 1980, and the Government planned an expansion of facilities in order to reduce dependence on imported cement.

The Saudi Cement Co. plant, located at Hofuf in Eastern Province, was to be expanded from a capacity of 400,000 tons to 1.3 million tons per year. The Yamama Saudi Cement Co. Ltd. plant, located at Riyadh, was also to be expanded from 400,000 tons to 1.3 million tons per year. Polysius AG (West Germany) was contracted for the expansion work at both facilities. The Arabian Cement Co., which operated a 700,000-ton-per-year plant at Jidda, was to build a 1-million-ton-per-year plant at Rabigh, 120 kilometers north of Jidda.

Four other cement plants were in various stages of planning in 1976. The Saudi-Bahraini Cement Co., owned 75% by the Saudi Cement Co. and 25% by the Bahraini Government, was to construct a 2-million-ton-per-year cement plant at Abqaiq in Eastern Province. Two Japanese firms, Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) and Nichimen Co., Ltd., were to complete the construction of the plant by 1980. The Saudi-Kuwaiti Cement Co., owned 55% by Saudi Arabia and 45% by Kuwait, was to undertake the construction of a 2-million-ton-per-year plant in the partitioned Neutral Zone. In addition, the Saudi Government contracted Klockner-Humboldt Deutz (West Germany) for the construction of a 730,000-ton-per-year plant at Quassim-Buredah in Central Province, and Cementa AB of Sweden for the construction of a 1-million-ton-per-year plant at Yanbu.

Fertilizer Materials.—The Saudi Government postponed indefinitely plans to increase the country's fertilizer production capacity. Although designed to produce 1,100 tons per day of urea from 600 tons of ammonia, the Saudi Arabian Fertilizer Co. (SAFCO) plant has not exceeded a production of 600 tons per day of urea. The SAFCO plant, located at Dammam, was owned 51% by SABIC and 49% by private Saudi investors.

Phosphate.—The Saudi Government concluded an agreement with the Swedish firm Gränges AB to study phosphate deposits at Thaniyat in the northwestern corner of the country. Saudi Arabia was estimated to have reserves of 150 million to 300 million tons of phosphate ore in the northwestern Jauf-Sakaka sedimentary basin. Gränges was to undertake a 2-year (1977–78) feasibility study at a cost of $3.4 million. In the case of exploitation, a joint mining company was to be formed by the Government and Gränges on a 50–50 basis. Tests previously conducted by Gränges on methods of concentrating the phosphate were to be continued in a pilot plant under construction.

Salt.—Salt was produced by solar evaporation or primitive means in several localities in Saudi Arabia. Plans to exploit two large rock salt deposits were not yet put into effect. The Jizan salt domes, 600 kilometers south of Jidda, were estimated to contain 33 million tons of 96% pure sodium chloride. Another deposit of equal or greater size was located south of Dhahran on the Persian Gulf.

Sulfur.—The Petromin Sulfuric Acid plant (PETROCID) was expanded to process about 20,000 tons per year of sulfur obtained from natural gas processed at the SAFCO plant. The sulfuric acid output of PETROCID, located at Dammam, was sold to local industries and desalination facilities.

MINERAL FUELS

Natural Gas.—Saudi Arabia's proven natural gas reserves were reported at 80 trillion cubic feet, consisting almost exclusively of associated gas. Two deposits of

nonassociated gas, one near Dhahran and the other in Rub' al Khali, produced small amounts of gas for domestic consumption. Aramco, which was the operator and a partial owner of Saudi Arabia's gas-gathering system, continued exploration for natural gas in Rub' al Khali.

In 1976, natural gas production was estimated at 4.5 billion cubic feet per day, 80% of which was flared. Of the remainder, approximately 600 million cubic feet per day was reinjected, used as fuel locally, or piped to fuel other industries. Facilities at Ras Tanura and Abqaiq separated about 300 million cubic feet per day into propane, butane, and natural gasoline for export. In 1976, NGL production increased 33% over that of 1975 to 185,000 barrels per day; all production was exported making Saudi Arabia the world's largest exporter of NGL.

Work continued on the Aramco project to double its NGL production capacity to 360,000 barrels per day. A $1 billion NGL recovery and treatment system was to come onstream at Berri in 1977. The commissioning of several new facilities increased NGL production capacity nearly 60% in 1976. Fluor Engineers and Constructors Inc. was contracted for the Berri plant, which was to supplement Aramco's NGL facilities at Abqaiq and Ras Tanura. Production was to eventually comprise 210,000 barrels per day of NGL for export and 380 million cubic feet per day of gas for fuel for the Jubail industrial complex.

Aramco was also contracted by the Saudi Government to plan, construct, and operate a major gas-gathering system alongside its own operations. The original scheme called for the construction of NGL-processing centers at Shedgum, Uthmaniyah, Safaniya, and Khurais. These plants were to produce a residual pipeline gas for fuel and NGL to be pumped to a fractionation plant at Ju'aymah. The project was to process 6 billion cubic feet per day of associated gas and produce 2.5 billion cubic feet per day of gas fuel, 960,000 barrels per day of NGL, 400 barrels per day of ethane (to be used as feedstock for petrochemical plants), and 6,000 tons per day of sulfur. However, owing to high costs, a poor market forecast, and ceilings on petroleum production, the project was subject to reappraisal in 1976. Originally estimated at $5 billion, cost projections for the gas gathering were reported to total $16 billion. The system was to be scaled down to an oil production rate of 10 million barrels per day from an original rate of 12 million barrels per day. The completion date was extended from 1979 to the mid-1980's. The Ju'aymah fractionation plant was to be the first operational unit; it was scheduled for completion in 1981 at an initial processing capacity of 300,000 barrels per day. Construction work also began in 1976 at the Shedgum and Uthmaniyah facilities. The principal contractors were Fluor Engineers and Constructors for project design and management, Bechtel International Ltd. for design of gas and NGL pipelines, the Ralph M. Parsons Co. Ltd. for design of utility plants and sulfur-recovery facilities, and Hudson Engineering Corp./J. Ray McDermott & Co., Inc., for the design of offshore pipelines and separation facilities. Fluor Engineers and Constructors also received letters of intent from Aramco for preliminary engineering work for an NGL plant and terminal at Yanbu on the west coast.

Petroleum.—*Production.*—In 1976, the Saudi Government and Aramco reached general accord on the principal issues of a 100% takeover of the company's assets in Saudi Arabia. Saudi Arabia had acquired 60% ownership of Aramco in 1974; the remaining 40% was owned by Exxon Corp., Mobil Oil Corp., Standard Oil Co. of California, and Texaco Inc.

According to the March 1976 agreement, Saudi Arabia was to pay compensation for Aramco's assets on the basis of their net book value. Aramco was to operate and market the bulk of production, with buying companies taking crude in the previous volumes and proportions. Petroleum exploration was to be conducted by the companies with their own risk capital, but bonuses, fees, and extra crude oil entitlements were to be received for successful results. Aramco was to receive a fee for its services in the form of discounts on each barrel of crude lifted. The Government was to set prices for crude, but those charged to the oil companies were not to be higher than those charged to third-party customers. Aramco was to retain a 50% interest in the Ras Tanura refinery, which processed nearly 70% of Saudi Arabia's crude oil production. The effective takeover date was January 1, 1976,

but details of the arrangement had not been worked out by yearend 1976.

The Saudi Government, which had previously imposed a production ceiling of 8.5 million barrels per day on Aramco, authorized a production increase to 10.5 million barrels per day in December 1976. The Aramco concession covered 222,000 square kilometers and comprised 37 major oilfields. Under a 3-year expansion program, production capacity was to be increased to more than 14 million barrels per day. In 1976, the Ghawar Field, rated as the world's largest oilfield with reserves of 68 billion barrels, produced 5,367,000 barrels per day. Construction began on a seawater treatment plant at Qurayyin as part of a project to inject 4.2 million barrels per day of water in Ghawar by mid-1978.

The Safaniya Field, rated as the world's largest offshore oilfield, was also undergoing capacity expansion. The Safaniya Field extended into the partitioned Neutral Zone, the Saudi portion of which contained reserves of 25 billion barrels. The most recent producing fields were the offshore Zuluf and Marjan Fields, which produced 200,000 barrels per day out of a combined capacity of 450,000 barrels per day. However, both fields were shut down in early 1976 owing to the production ceiling.

Aramco added 3.2 billion barrels to its proven reserves through the discovery of three new oilfields in 1976: The Hasbah Field, located 30 kilometers offshore south of the Marjan Field; the Sharar Field, located offshore 10 kilometers west of the Manifa Field; and the Suban Field, located onshore 100 kilometers southeast of the partitioned Neutral Zone. The Watban Field, located 20 kilometers west of Juraybat, was drilled in 1975 and determined commercial in 1976. Aramco drilled a total of 193 wells in its concession area during 1976. Petromin also conducted petroleum exploration in its concession area, which covered 110,000 square kilometers in Rub' al Khali and along the Red Sea coast.

Kuwait and Saudi Arabia shared the production of the partitioned Neutral Zone, where Saudi oil was produced by AOC and GOC. AOC planned to increase production of its offshore Khafji and Hout Fields to 385,000 barrels per day by 1978. The GOC concession covered all of the onshore partitioned Neutral Zone and 6 miles of the offshore territorial waters, and was operated in conjunction with American Independent Oil Co. (Aminoil). Total estimated reserves of the Wafra, South Umm Gudair, and South Fawaris Fields were 600 million barrels. In 1976, GOC was renegotiating its contract with Saudi Arabia which sought an increase in royalty and income tax rates.

Pipelines.—Aramco completed and put into service 222 kilometers of pipeline during 1976, 60% of which was for natural gas and NGL transmission. Contracts were granted for the construction of Saudi Arabia's longest crude oil pipeline, which was to transit the peninsula linking the eastern oilfields with Yanbu on the west coast. The 48-inch, 1,207-kilometer line was to carry 1.85 million barrels per day of oil from the Ghawar and Khurais Fields to the new Yanbu refinery and for export from Red Sea ports. The $1.6 billion pipeline was scheduled to be completed in 1981; further expansion was to increase capacity to 2.3 million barrels per day by 1985. Brown & Root Ltd. was awarded the design and engineering contracts for the line and Mobil Overseas Pipeline Co. was contracted for construction work. Contracts were not yet awarded for the NGL pipeline, which was to parallel the crude oil line and carry 250,000 barrels per day of NGL to the planned Yanbu petrochemical complex.

Ownership of the Trans-Arabian Pipe Line Company (TAPline) was to revert to the four participating oil companies—Exxon, Texaco, Standard Oil of California, and Mobil—upon completion of the takeover of Aramco. The 31-inch TAPline crossed Saudi Arabia (867 kilometers), Jordan (177 kilometers), Syria (127 kilometers), and Lebanon (42 kilometers) in carrying crude oil to the Mediterranean port of Sidon in Lebanon. Normal operations of TAPline were suspended in 1975 when it became more economical to ship oil by supertanker from the Persian Gulf. In 1976, TAPline carried limited amounts of crude oil to supply local needs in Jordan and Lebanon.

Refining.—Five refineries with a total capacity of approximately 600,000 barrels per day operated in Saudi Arabia in 1976, as follows:

Company	Location	Startup date	Capacity (barrels per day)
Aramco	Ras Tanura	1945	415,000
GOC	Mina Sa'ud	1958	100,000
AOC	Ras al-Khafji	1966	30,000
Petromin/Saudi Arabian Refinery Co. (SARCO)	Jidda	1968	40,000
Petromin	Riyadh	1975	15,000

Petromin planned to expand its two refineries and entered into joint ventures for the construction of new petroleum and lubricating oil facilities. The Jidda refinery, owned 75% by Petromin and 25% by SARCO, was to be expanded from 40,000 barrels to 210,000 barrels per day. The Riyadh refinery, which was supplied by a 170-kilometer pipeline from the Khurais Field, was to be expanded from 15,000 barrels to 100,000 barrels per day. The emphasis in both the Jidda and Riyadh projects was to be on maximizing the yield of light products. Construction contracts were concluded with the Japanese firms Chiyoda Chemical Engineering & Construction Co., Ltd., and Mitsubishi Corporation.

Two large export refineries were planned for the new industrial centers of Jubail and Yanbu. A 50–50 joint venture between Petromin and Shell was formed for the construction of a 250,000-barrel-per-day refinery at Jubail, to be completed in 1978. Petromin and Mobil entered into a 50–50 joint venture for the construction of a 250,000-barrel-per-day refinery at Yanbu, to be completed in 1984. Each refinery was to cost approximately $1 billion and was to be expanded to 500,000 barrels per day at a later date.

The Petromin Lubricating Oil Co. (Petrolube) was to be expanded from a 75,000-barrel-per-year to a 500,000-barrel-per-year blending capacity. Petrolube, which manufactured, blended, and stocked basic lubricating oils, was owned 61% by Petromin, 36% by Mobil, and 3% by the Saudi company Apsco. Petromin and Mobil began the construction of a second lubricating oil plant in Jidda, which was to produce 1 million barrels of lubricating oil base stocks per year. The $1 billion venture was owned 70% by Petromin and 30% by Mobil.

Petrochemicals.—Saudi Arabia allotted $18 billion of its 5-year plan expenditures to petrochemical development. Joint ventures were entered into for the construction of five petrochemical complexes, but none were to be operational before 1980. Combined output of the plants was to be more than 2 million tons per year of ethylene equivalent for export. In all the agreements, the foreign company was to undertake management of the plant and marketing of products. The Saudi Government and the foreign company were to provide equal shares of the equity, with the remaining financing to be obtained from commercial banks and the Saudi Public Investment Fund.

Four of the complexes were to be located in the Jubail industrial center. Exxon signed an interim agreement for a $720 million joint venture complex to produce 240,000 tons per year of ethylene and low-density polyethylene. Dow Chemical Co. was to undertake the construction of an $800 million plant to produce 250,000 tons per year of ethylene, low-density polyethylene, and glycol. Shell signed a $10 million contract for economic and engineering studies for a 500,000-ton-per-year plant to produce ethylene-based petrochemicals. In 1976, Mitsubishi requested a 3- to 5-year postponement on the construction of a 300,000-ton-per-year plant to produce ethylene, glycol, ethylene dichloride, and caustic soda. Mitsubishi signed the original contract for the $2 billion plant in 1970.

The fifth facility was to be located at Yanbu on the west coast. Mobil signed a $10 million contract for initial technical and economic studies for the petrochemical complex. The Yanbu facility was to process ethylene transported by pipeline from the east coast and produce 500,000 tons per year of polyethylene, glycol, and styrene.

Table 4.—Saudi Arabia: Selected oilfields, 1976

Company and oilfield	Discovery date	Average production (barrels per day)	Gravity (degrees API)	Sulfur content (percent)
Saudi Arabia:				
Aramco:				
Abqaiq	1940	834,000	36	1.3
Abu Hadriya	1940	96,000	35	1.6
Abu Safah	1963	106,000	30	2.6
Berri	1964	768,000	33–39	1.2–1.9
Dammam	1938	13,000	33	1.5
Fadhili	1949	37,000	37	1.1
Ghawar	1948–57	5,367,000	33	1.0–2.2
Harmaliyah	1966	98,000	32	NA
Khurais	1956	36,000	33	1.9
Khursaniyah	1957	81,000	31	2.4
Manifa	1957	20	29	2.9
Marjan	1967	610	33	NA
Qatif	1945	82,000	32	1.6
Safaniya	1951	847,000	27	2.9
Zuluf	1965	1,000	32	NA
Partitioned Neutral Zone:				
AOC:				
Hout	1963	48,000	35	1.4
Khafji	1960	199,000	28	2.8
GOC:				
South Fawaris	1963	3,000	24	3.8
South Umm Gudair	1966	50,000	25	3.9
Wafra	1953	107,000	18–29	3.8

NA Not available.

The Mineral Industry of Sierra Leone

By Candice Stevens [1]

Decreased mineral production, particularly that of iron ore and diamond, contributed to the depressed level of economic activity in Sierra Leone in 1976. The increased cost of imports, stagnation in exports, and decline in capital inflows necessitated major revisions in the investment program of the 1974–79 development plan, including a 15% reduction in expenditures by all Government departments. In an additional effort to offset the Government budget deficit, a number of new tax measures were introduced, including an increase in company taxation to 55%, a consular fee of 1.5% on all imported goods, and a general increase in custom and excise duties. Also in 1976, the United States announced that it would resume bilateral aid to Sierra Leone, after a lapse of 8 years, to be channeled through the Agency for International Development (AID).

Plans were being finalized for the construction of a large hydroelectric plant on the Sewa River near Bumbuna. Expansion of the mining sector was to be assisted by improved infrastructure. A network of all-weather roads was recently completed, linking Freetown, the capital, with each of the provincial capitals and with the principal diamond area. There were plans to construct more than 800 kilometers of additional roads.

PRODUCTION AND TRADE

Production of Sierra Leone's major mineral commodities, diamond and bauxite, declined in 1976, as well as output of refined petroleum products. Production of iron ore, which previously accounted for 10% of export earnings, ceased in 1975 owing to the liquidation of Sierra Leone Development Co., Ltd. (DELCO). Mineral production figures are given in table 1.

Sierra Leone's balance-of-trade deficit increased from $44 million [2] in 1975 to $59 million in 1976. This was attributable to a decline in export value from $132 million in 1975 to $100 million in 1976. Efforts to reduce the import bill resulted in a decrease from $176 million in 1975 to $159 million in 1976, but this was not sufficient to offset the decline in exports.

Diamond production, which accounted for approximately 53% of total export value, was sold to the Central Selling Organization, Diamond Corporation of West Africa Ltd. (DICORWAF), and a small number of licensed buyers. All bauxite was exported unprocessed, principally to Switzerland, the Netherlands, and Canada. Approximately 350,000 barrels of petroleum products from the Freetown refinery (25% of production) was exported in 1976, primarily to Liberia. Sierra Leone imported about 1.6 million barrels of crude oil, 92% of which was from Nigeria. Overall, the United Kingdom remained Sierra Leone's principal trading partner, supplying more than 27% of total imports and receiving more than 55% of total exports.

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[1] Economist, International Data and Analysis.

[2] Where necessary, values have been converted from Sierra Leonean leones (Le) to U.S. dollars at the rate of Le0.9=US$1.00.

During the year, Sierra Leone and Liberia signed an agreement to harmonize their customs duties and establish a common external tariff. These provisions, which were to become effective April 1, 1977, were established under the Mano River Union formed in 1973 to foster economic cooperation between the two countries. The Mano River Union was open to participation by other western African countries, particularly the remaining members of the Economic Community of West African States (ECOWAS).

Table 1.—Sierra Leone: Production of mineral commodities

Commodity [1]		1974	1975	1976 [p]
Aluminum, bauxite, gross weight	thousand metric tons	672	655	651
Diamond:				
Gem	thousand carats	670	[e] 560	433
Industrial	do	1,000	[e] 840	650
Total	do	1,670	[e] 1,400	1,083
Iron ore, gross weight	thousand metric tons	2,014	1,454	--
Petroleum refinery products:				
Gasoline	thousand 42-gallon barrels	369	797	231
Jet fuel	do	144	201	109
Kerosine	do	153	56	185
Distillate fuel oil	do	469	304	407
Residual fuel oil	do	536	--	423
Other	do	12	61	3
Refinery fuel and losses	do	68	--	29
Total	do	1,751	1,419	1,387

[e] Estimate. [p] Preliminary.
[1] In addition to the commodities listed, a variety of crude construction materials (clays, sand and gravel, and stone) is produced, but quantities are not reported and available general information is inadequate for the formulation of reliable estimates of output levels. Gold production may occur, but data are not available for estimating production. Sierra Leone annually refines 4,000 to 10,000 metric tons of salt from imported crude marine salt, but this is not included in the body of the table because it would represent double counting of material credited to the country where the salt was originally collected.

COMMODITY REVIEW

METALS

Bauxite.—Production of bauxite by Sierra Leone Ore and Metal Co. (SIEROMCO), a wholly owned subsidiary of Swiss Aluminium Ltd. (Alusuisse), decreased from 655,000 tons in 1975 to 651,000 tons in 1976. SIEROMCO has mined bauxite in the Mokanji Hills area near Moyamba in southwestern Sierra Leone since 1963. Reserves in this region were estimated at 70 million tons of ore containing 47% Al_2O_3 and 4.5% SiO_2. Alusuisse, in conjunction with the Norwegian firms Norsk Hydro A/S and A/S Ardal og Sunndal Verk, was planning a second bauxite operation at Port Loko. Reserves were estimated at 60 million tons containing 50% Al_2O_3. The proposed operation would employ up to 2,000 people and extract 1.5 million tons of bauxite annually. Construction of an alumina refinery at Port Loko was also under consideration.

In 1976, SIEROMCO and the Sierra Leonean Government concluded negotiations regarding ownership of the Mokanji mine, which have proceeded intermittently since 1972. SIEROMCO was to continue the operation without Government partnership until 1978 when mining leases will expire and are to be renegotiated, but its royalties and mining lease fees were doubled and company taxes were raised from 52% to 60%. SIEROMCO reportedly offered the Government a majority partnership in the larger bauxite venture proposed for Port Loko. The International Bauxite Association, of which Sierra Leone has been a member since its founding in 1974, met in Freetown in November 1976 to develop minimum pricing formulas for bauxite and alumina, but adjourned without a final consensus.

Iron.—No iron ore has been mined in Sierra Leone since the liquidation of DELCO's operations in October 1975. Es-

tablished in 1930, DELCO started mining the Marampa deposits in Port Loko District in 1933. Production increased from 24,000 tons in 1933 to 1.5 million tons in 1975, when Sierra Leone joined the Association of Iron Ore Exporting Countries. Reserves at the Marampa deposits were estimated at 67 million tons of 38% iron in 1974. Reserves at a second location, Tonkolili, about 80 kilometers northeast of Marampa, were estimated at 124 million tons of 55% to 56% iron. DELCO's major creditors included William Baird & Co. Ltd. (Scotland), Barclays Bank Limited (United Kingdom), three Japanese steel companies, and the Sierra Leonean Government. In 1976, the Government made an offer of $1 million for the major realizable assets of DELCO. Negotiations continued throughout the year with Bethlehem Steel Corp. (United States), which was considering reopening the Marampa mine and exploiting the Tonkolili deposits as a joint project with the Government.

Tin.—In 1976, the Government invited bids for prospecting and developing cassiterite deposits in Kongombadu, located 24 kilometers northeast of Yengema in Kono District; Mimini Hills, located 16 kilometers from Sefadu in Kono District; and Kalangba, located 24 kilometers from Makeni in Northern Province.

Titanium.—Sierra Rutile Ltd. (SRL), a joint venture of Bethlehem Steel (85%) and Nord Resources Corp. (15%), continued development of its rutile operation at Gbangbama in Moyamba District. Reserves were estimated at 187 million tons of black sands containing 3 million tons of rutile. In 1976, the design for extraction and processing facilities was completed, including a custom-designed bucket-ladder dredge. Primary concentration is to be through a gravity-separation system consisting of Reichert Cones and concentrating tables, and finishing is to be by electrostatic separation. Onsite construction is to begin in spring 1977, and production of 100,000 to 125,000 tons of rutile is scheduled for late 1978. SRL acquired the Gbangbama leases from Sherbro Minerals Ltd., which liquidated in 1971 after preliminary development of the project.

A joint subsidiary of the West German firms Bayer A.G. and Preussag Metal A.G. continued with exploration work, water supply investigations, and construction of a pilotplant in their rutile concession. Bayer-Preussag acquired a 5-year exclusive prospecting license on a 6,700-square-kilometer area of Southern Province in 1974. Reserves at deposits in Moyamba and Bonthe Districts were estimated at 11 million tons of 0.75% to 1.0% rutile.

NONMETALS

Cement.—Since the closing of Sierra Leone Cement Works Ltd. in 1970, all of Sierra Leone's cement needs have been imported, primarily from Egypt and Europe.

Clays.—In 1976, an agreement was signed with Hoeke Engineering of Belgium for the construction of a brick-manufacturing factory in Freetown. The $7 million plant is to open in 1977 and was expected to reduce Sierra Leone's dependence on imported cement. Locally produced materials, including clay, sand and gravel, and stone, were to be used in the production of 80,000 tons of brick per year. Discussions were in progress with the Republic of Korea for the construction of a ceramics factory in the same vicinity.

Diamond.—Diamond production continued a downward trend, declining from 1.4 million carats in 1975 to approximately 1.1 million carats in 1976. Diamond occurs in the lower basin of the Sewa River in southeastern Sierra Leone. The primary source of alluvial diamond is Cretaceous kimberlite dikes and small pipes presumed to have intruded in Precambrian granites. About 50% of production and approximately 41% of reserves were from deposits occurring in the channels of the principal rivers, the Sewa, Bafi, Male, and Moa.[3]

The major share of the diamond production was by National Diamond Mining Co. (DIMINCO), created in 1970 when the Government purchased 51% of Sierra Leone Selection Trust Ltd., a subsidiary of Consolidated African Selection Trust. DIMINCO's two concessions, one in the Yengema region of Kono District and one in the Tongo region, 50 kilometers south of Yengema, comprised 805 square kilometers. In 1976, DIMINCO announced major management changes as part of an

[3] Bardet, M. G. Géologie du Diamant. Deuxieme Partie: Gisements de Diamant d'Afrique (Geology of Diamond. Part Two: African Diamond Deposits). Bureau de Recherches Géologiques et Minières, Paris. 1974, pp. 176–188.

attempt to increase Sierra Leonean participation in the diamond-mining industry. For the first time, the positions of general manager, chief accountant, and senior geologist were to be held by Sierra Leoneans. In addition, contract mining privileges within the Kono concession were to be extended to certain sections of the Kono population. DIMINCO's operations involved the removal of a great deal of overburden to mine lower-grade deposits; in the face of diminishing reserves, DIMINCO undertook prospecting in new areas in the southern part of Sierra Leone. One-half of DIMINCO's production was sold to DICORWAF, a subsidiary of De Beers Consolidated Mines Ltd., while five licensed buying firms received fixed percentages of the remaining output.

The balance of the diamond production was controlled by the Alluvial Diamond Mining Scheme (ADS), established in 1956 to discourage illicit digging. Licenses were issued to Sierra Leoneans or firms with a Sierra Leonean majority for individual diamond digging in 23,000 square kilometers of designated area outside the DIMINCO concessions. The diggers, who for the most part continued to recover diamond by primitive hand-panning methods, were permitted to work in a maximum area of 4 acres for a period of about 6 months. In 1976, the number of mining licenses issued under the ADS declined owing to excessive rains during the year.

Diamond smuggling continued to present a problem to the Sierra Leonean Government, which announced a new campaign to curb illicit dealings. All licensed diggers were to submit accounts of their mining operations, and penalties for diamond smuggling were to be increased from a $200 fine or 6-month imprisonment to a $10,000 fine or 12-month imprisonment.

MINERAL FUELS

Petroleum.—Offshore exploration, which had previously yielded no commercial petroleum or natural gas deposits, was at a standstill in 1976 with the expiration of most prospecting licenses. Sierra Leone Petroleum Refining Co., whose refinery opened in Freetown in 1976, processed crude oil imported primarily from Nigeria. Although the refinery's reported annual capacity was about 3 million barrels, output was running at 1.4 million barrels per year. The refinery was jointly owned by the Sierra Leonean Government and five oil companies: British Petroleum Co. Ltd., Texaco Inc., Shell Oil Co., Mobil Oil Corp., and Azienda Generale Italiani Petroli S.p.A. (Agip). In 1976, a plant for production of bottled gas for home use came onstream. The gas was supplied by Sierra Leone Refining Co., and the bottling plant was jointly owned by Shell and Mobil.

The Mineral Industry of the Republic of South Africa

By Miller W. Ellis [1] and Charles W. Sweetwood [2]

The Republic of South Africa's mineral industry contributed greatly to the country's economy, and industries based on mineral products supported the country's position as the dominant commercial and economic nation of the African continent. Mineral products accounted for more than 16% of the gross domestic product (GDP) and more than one-half of export sales. Domestic sales of minerals increased slightly, but the value of imports (excluding petroleum) increased more than 20% as restrictions were lowered because of increased demand from domestic consumers.

The value of mineral production exceeded $5 billion for the third consecutive year, reaching a total of $5.4 billion [3] out of a GDP of $33.37 billion. The value of mineral production increased nearly 10% and the GDP increased 12% in terms of domestic currency. Both the Government and private industry continued with scheduled expansion programs, but no new major undertakings were announced. The Government-controlled South African Iron and Steel Industrial Corporation Ltd. (ISCOR) completed the railroad from Sishen in the northern part of Cape Province to its new port at Saldanha Bay from which iron ore was exported after September 23, 1976. South African Coal, Oil, and Gas Corp., Ltd. (SASOL) started work on its new Secunda colliery and oil-from-coal plant.

After taking over ISCOR's Grasvally Chrome Mine and Ferrometals Ltd.'s ferrochrome plant at Witbank in return for a 45% holding interest, the private-sector South African Manganese Amcor Ltd. (SAMANCOR) became the country's leading manganese and ferroalloy producer. Coal-loading equipment was installed at Richard's Bay, and ore-loading facilities were improved at Durban, East London, and Port Elizabeth. An offshore oil discovery was reported southeast of Cape Agulhas in December.

PRODUCTION

The Republic of South Africa remained the world's leading producer of chromite, gem diamond, gold, platinum, and vanadium and was one of the top three producers of antimony, asbestos, industrial diamond, manganese, uranium, and vermiculite. Important quantities of cement, coal, copper, fluorspar, iron, phosphate, salt, tin, and zinc were produced for export as well as for domestic industry. Details of mineral production are shown in table 1.

[1] Physical scientist, International Data and Analysis.

[2] Regional resources officer, U.S. Consulate General, Johannesburg, Republic of South Africa.

[3] Where necessary, values have been converted from South African rands (R) to U.S. dollars at the devaluated rate of R1=US$1.15 for 1976 and the average rate of R1=US$1.3663 for 1975, as shown in International Financial Statistics, V. 30, No. 2, p. 320.

Table 1.—Republic of South Africa: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum metal	75,000	75,900	78,400
Antimony concentrate:			
Gross weight	25,212	26,160	18,341
Metal content	15,170	15,924	10,785
Beryllium, beryl concentrate, 11% to 12% BeO	2	3	3
Chromium, chromite, gross weight:			
Less than 44% Cr_2O_3	917,809	932,629	1,071,747
44% to 48% Cr_2O_3	938,573	1,127,519	1,311,894
More than 48% Cr_2O_3	20,531	15,230	25,594
Total	1,876,913	2,075,378	2,409,235
Columbium-tantalum concentrate kilograms	300	--	--
Copper:			
Mine output, metal content	179,111	178,927	196,880
Metal:			
Smelter	147,800	149,700	159,300
Refined	88,500	86,400	89,700
Gold, primary thousand troy ounces	24,388	22,938	22,936
Iron and steel:			
Iron ore and concentrate thousand tons	11,553	12,298	15,663
Pig iron do	4,621	5,177	5,798
Ferroalloys do	r 637	748	823
Crude steel do	r 5,764	6,499	7,083
Semimanufactures:			
Cast iron and steel do	546	652	629
Rolled products do	3,896	4,176	4,300
Lead, mine output, metal content	2,487	2,704	--
Manganese ore and concentrate, gross weight:			
Metallurgical:			
More than 48% Mn	1,138,323	199,274	269,608
45% to 48% Mn	218,185	1,379,230	1,517,353
40% to 45% Mn	264,464	232,947	209,346
30% to 40% Mn	3,026,152	3,872,052	3,358,080
Total	4,647,124	5,683,503	5,354,387
Chemical:			
More than 65% MnO_2	4,996	6,849	2,733
35% to 65% MnO_2	93,266	78,680	95,138
Total	98,262	85,529	97,871
Grand total	4,745,386	5,769,032	5,452,258
Manganiferous iron ore, 15% to 30% Mn, 20% to 35% Fe	89,602	111,703	50,964
Nickel:			
Mine output, metal content	22,100	20,754	22,371
Electrolytic metal	17,000	14,000	17,000
Platinum-group metals, metal content of concentrate, matte, and refinery products [1] thousand troy ounces	r 2,830	r 2,600	2,700
Silver metal, primary do	2,699	3,084	2,821
Tin:			
Concentrate:			
Gross weight	5,149	5,652	5,655
Metal content	2,542	2,643	2,799
Metal, primary	854	780	683
Uranium oxide (U_3O_8)	r 3,198	2,934	3,254
Vanadium:			
Vanadiferous slag, gross weight	34,522	41,690	45,061
Vanadium content of:			
Vanadiferous slag produced e	4,833	5,837	6,309
Vanadium pentoxide and vanadate products e	3,318	4,808	3,566
Total	8,151	10,645	9,875
Zinc:			
Concentrate:			
Gross weight	67,993	127,624	149,922
Metal content	33,995	63,812	74,961
Smelter	65,400	63,700	66,200
Zirconium concentrate (baddeleyite)	11,978	11,594	11,252
NONMETALS			
Asbestos:			
Amosite	94,543	88,411	78,898
Chrysotile	82,430	99,660	111,025
Crocidolite [2]	r 156,299	166,639	179,917
Total	333,272	354,710	369,840
Barite	1,547	795	1,915
Cement, hydraulic thousand tons	r 7,301	7,176	e 7,200

See footnotes at end of table.

Table 1.—Republic of South Africa: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS—Continued			
Clays:			
Bentonite	37,803	37,549	39,602
Fire clay	332,066	294,086	207,195
Flint clay	303,859	255,100	190,731
Kaolin	48,844	56,808	59,733
Corundum, natural	252	241	142
Diamond:			
Gem thousand carats	r 3,440	3,435	3,339
Industrial do.	r 4,070	3,860	3,684
Total do.	7,510	7,295	7,023
Diatomite	786	649	619
Feldspar	39,540	30,354	46,138
Fertilizer materials, crude, natural: Phosphate rock thousand tons	7,824	11,626	12,362
Fluorspar:			
Acid grade	193,565	172,270	210,874
Ceramic grade	4,989	10,294	39,502
Metallurgical grade	9,379	20,019	40,342
Total	207,933	202,583	290,718
Gem stones, semiprecious:			
Emerald crystals kilograms	2,242	2,375	1,494
Tiger's eye do.	112,968	187,175	206,210
Graphite	1,554	523	530
Gypsum, crude	563,448	538,622	482,375
Kyanite and related materials:			
Andalusite	64,008	77,149	77,464
Sillimanite	13,087	16,911	25,733
Lime thousand tons	1,199	1,328	1,387
Lithium minerals (spodumene)	1	--	--
Magnesite, crude	104,614	61,202	62,858
Mica:			
Sheet kilograms	321	--	220
Waste	2,696	2,511	2,380
Pigments, mineral, natural:			
Ochers	2,061	1,368	1,288
Oxides	562	1,361	755
Umber	--	556	368
Pyrite, gross weight	570,840	650,738	845,384
Quartz, quartzite, glass sand (silica)	898,230	1,155,503	1,225,413
Salt	220,839	264,412	223,662
Silcrete	15,234	8,086	5,979
Stone, sand and gravel, n.e.s.:			
Dimension stone:			
Granite: [3]			
Sawn slabs	22,909	33,576	32,316
Rough blocks	318,918	282,341	263,367
Marble	18,120	21,839	16,220
Crushed and broken stone:			
Limestone [3] thousand tons	14,887	13,737	13,739
Shale do.	517	393	369
Sulfur:			
Content of pyrite do.	228	260	338
Byproduct:			
From metallurgy do.	70	80	91
From petroleum do.	28	25	27
Total do.	r 326	365	456
Talc and related materials:			
Pyrophyllite (wonderstone)	8,510	6,782	5,784
Talc	9,589	9,236	7,039
Vermiculite	182,613	207,529	222,077
MINERAL FUELS AND RELATED MATERIALS			
Carbon black e	37,500	40,400	43,100
Coal:			
Anthracite thousand tons	1,435	1,591	2,459
Bituminous do.	64,621	67,849	74,600
Total do.	66,056	69,440	77,059
Coke:			
Oven and beehive do.	e 3,600	4,443	4,608
Gashouse, low- and medium-temperature e do.	100	100	100

See footnotes at end of table.

Table 1.—Republic of South Africa: Production of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
MINERAL FUELS AND RELATED MATERIALS—Continued			
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	26,039	31,939	29,783
Jet fuel ---do	2,297	3,144	2,196
Kerosine ---do	2,339	3,400	3,132
Distillate fuel oil ---do	20,923	30,220	31,279
Residual fuel oil ---do	21,440	29,454	22,027
Lubricants ---do	1,812	2,171	2,228
Other ---do	2,741	7,715	8,581
Refinery fuel and losses ---do	5,123	6,651	5,561
Total ---do	82,714	114,694	104,787

e Estimate. p Preliminary. r Revised.
[1] Data include osmiridium from gold ore estimated at 2,500 troy ounces each year.
[2] Includes asbestos reported in source as anthophyllite, Cape blue, and Transvaal blue.
[3] Local sales plus exports. Production not reported.

TRADE

South African minerals continued to be important to the world economy. The importance of the country's industrial and transport facilities to the mineral production of other countries in southern Africa became increasingly apparent in 1976 when rail and port facilities in Mozambique were undependable and those in Angola remained closed. While gold continued to be the Republic's major source of foreign exchange, the trade balance was adversely affected by oil imports.

Table 2.—Republic of South Africa: Exports of selected mineral commodities[1]
(Metric tons unless otherwise specified)

Commodity	1973	1974	1975
METALS			
Aluminum metal, unwrought[2]	5,200	13,900	13,700
Antimony ore and concentrate, gross weight	29,794	r 22,530	12,247
Beryllium, beryl concentrate, gross weight	149	--	15
Chromium:			
Chromite ore and concentrate, gross weight:			
Less than 44% Cr_2O_3	480,064	489,086	473,603
44% to 48% Cr_2O_3	468,210	291,676	433,648
More than 48% Cr_2O_3	--	73	--
Total	948,274	780,835	907,251
Chrome sand, gross weight:			
Less than 44% Cr_2O_3	14,562	9,146	40,480
44% to 48% Cr_2O_3	129,910	272,486	301,674
More than 48% Cr_2O_3	96	--	--
Total	144,568	281,632	342,154
Copper, blister and refined, unwrought	111,862	e 122,938	e 101,051
Iron and steel:			
Iron ore, gross weight:			
Hematite	2,599,875	2,119,331	e 2,522,725
Magnetite	818,861	e 774,237	e 814,379
Total	3,418,736	2,893,568	3,337,104
Metal:			
Scrap[3]	1,000	100	5,700
Pig iron	[3] 442,200	[3] 179,300	1,400
Sponge iron and powder[3]	400	19,600	15,800
Ferroalloys:[3]			
Ferromanganese	276,300	346,900	276,000
Ferrochrome	175,200	194,800	283,700
Ferrosilicon	36,500	40,100	36,100
Other	25,400	38,800	34,100
Ingots and other primary forms[3]	90,800	100,400	31,300

See footnotes at end of table.

Table 2.—Republic of South Africa: Exports of selected mineral commodities [1] —Continued

(Metric tons unless otherwise specified)

Commodity	1973	1974	1975
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures: [3]			
Bars and rods	59,400	71,100	27,100
Angeles, shapes, sections	97,900	65,600	45,300
Plate and sheet	241,100	268,400	170,900
Hoop, strip, coil	22,000	28,100	5,100
Rails and accessories	35,900	31,600	20,600
Wire	8,200	8,500	5,600
Tubes, pipes, fittings (including cast pipe)	13,200	15,700	12,400
Castings and forgings	1,600	4,900	5,400
Total	479,300	493,900	292,400
Lead metal, unwrought	--	1,141	5,557
Manganese ore, gross weight:			
Metallurgical	3,509,337	3,020,892	3,401,376
Chemical	320	710	1,327
Manganiferous	167,516	116,859	237,684
Total	3,677,173	3,138,461	3,640,387
Nickel, unwrought	10,300	14,434	19,883
Platinum-group metals including alloys, all forms [e] thousand troy ounces	762	1,679	1,831
Tin concentrate, gross weight	1,613	1,768	2,273
Vanadium (V_2O_5 content) [e]	11,000	11,600	9,905
Zinc:			
Concentrate, gross weight	12,631	39,422	66,706
Metal, unwrought	--	--	3,000
Zirconium ore and concentrate (baddeleyite)	4,883	6,256	4,102
NONMETALS			
Asbestos:			
Amosite	101,361	90,109	173,165
Anthophyllite	178	484	1,406
Chrysotile	57,737	71,669	112,405
Cape blue	154,902	159,029	257,273
Transvaal blue	2,347	610	--
Total	316,525	321,901	544,249
Barite	5	--	--
Cement [e] thousand tons	50	354	343
Clays and clay products:			
Bentonite:			
Crude	1,493	1,675	1,595
Processed	472	101	158
Flint clay:			
Raw	9,137	678	2,443
Calcined	113,142	149,729	114,319
Fuller's earth	629	21	--
Kaolin:			
Crude	629	1,804	114
Milled		240	490
Washed		91	30
Feldspar	8,003	3,558	1,878
Fertilizer materials: Phosphate rock:			
Ore	1,206	7,000	--
Concentrate		30,097	13,229
Fluorspar:			
Acid grade	97,308	111,382	126,061
Ceramic grade	--	--	39
Metallurgical grade	17,228	12,206	454
Total	114,536	123,588	126,554
Gem stones: Emerald crystals kilograms	2,549	1,963	1,045
Graphite, processed	901	954	434
Gypsum	22,039	10,165	14,069
Kyanite and related materials:			
Andalusite	16,637	18,759	23,773
Sillimanite	15,363	18,737	16,524
Lime, slaked and other	57,863	41,902	41,809
Mica:			
Waste	3,794	2,535	510
Ground	2,805	2,037	2,542
Pigments, mineral:			
Ochers	1,584	1,601	896
Oxides	174	183	22
Salt	40,238	10,133	6,780

See footnotes at end of table.

Table 2.—Republic of South Africa: Exports of selected mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1973	1974	1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Granite:			
Sawn slabs	8,584	6,915	5,660
Raw blocks	296,519	305,813	225,746
Marble	--	4,887	2,097
Quartzite tiles	2,515	935	5,046
Slate (including paving)	2,330	2,618	2,221
Limestone	12,108	18,867	10,092
Silica:			
Crude	1,972	186	40
Processed	1,243	1,231	497
Talc and related materials:			
Talc and steatite	135	214	116
Wonderstone (pyrophyllite)	6,670	5,335	3,367
Vermiculite	142,874	149,665	185,943
MINERAL FUELS AND RELATED MATERIALS			
Coal:			
Anthracite ---thousand tons--	905	1,035	1,565
Bituminous ---do---	1,039	1,242	1,122

e Estimate. r Revised.

[1] Because official South African trade statistics provide data only on the total value of exports of each commodity class (no data on quantity or destinations), this table has been compiled chiefly from information appearing in the quarterly publication "Minerals" issued by the Department of Mines of the Republic of South Africa. Figures obtained from supplemental sources and U.S. Bureau of Mines estimates are individually footnoted.

[2] World Bureau of Metal Statistics. World Metal Statistics. July 1978, 108 pp.

[3] British Steel Corporation. International Iron and Steel Statistics—Republic of South Africa. 1973, 42 pp.; 1974, 42 pp.; 1975, 58 pp.

Table 3.—Republic of South Africa: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite	7,188	32,130	Australia 20,394; Denmark 2,519.
Oxide and hydroxide	r 169,488	140,499	Australia 134,680; Japan 2,890; United Kingdom 1,268.
Metal including alloys:			
Scrap	202	356	New Zealand 100; West Germany 75.
Unwrought	842	1,264	United Kingdom 278; West Germany 168; Japan 100.
Semimanufactures	12,086	12,284	United States 4,543; West Germany 2,683; United Kingdom 581.
Arsenic:			
Oxides and acids	r 116	105	Mainly from United Kingdom.
Metal	1	2	NA.
Chromium:			
Chromite	75,948	80,070	NA.
Oxide and hydroxide	469	296	West Germany 120; United Kingdom 55.
Cobalt oxide and hydroxide	15	16	Canada 7; Switzerland 3.
Copper:			
Ore and concentrate	76,770	11,076	Japan 1,008.
Metal including alloys:			
Scrap	1,088	369	West Germany 148.
Unwrought	9,713	4,221	West Germany 1,000.
Semimanufactures	4,490	5,965	West Germany 2,434; United Kingdom 1,280.
Gold metal, unworked or partly worked troy ounces--	11,462	9,196	United Kingdom 4,436; Switzerland 852.

See footnotes at end of table.

Table 3.—Republic of South Africa: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Iron and steel:			
Ore and concentrate	10,978	8,244	NA.
Metal:			
Scrap	10,383	18,022	United Kingdom 593.
Pig iron, ferroalloys, similar materials	r 9,237	48,530	Sweden 2,834; Japan 1,307; Norway 1,276.
Steel ingots and other primary forms	27,574	144,226	Japan 88,567; France 15,315; United States 13,430.
Semimanufactures:			
Bars and rods	160,260	136,546	Japan 37,167; West Germany 32,403; United Kingdom 24,994.
Angles, shapes, sections	63,196	50,648	West Germany 18,174; United Kingdom 14,920; Japan 13,684.
Plate and sheet	r 705,308	388,626	Japan 231,837; West Germany 84,249; United Kingdom 46,916.
Hoop and strip	r 46,009	13,947	West Germany 3,963; Japan 3,121; United Kingdom 2,392.
Rails and accessories	52,577	181,167	West Germany 99,377; France 46,263; Japan 19,952.
Wire and wire rod	r 23,224	15,888	Belgium-Luxembourg 2,864; West Germany 2,502; Japan 2,197.
Tubes, pipes, fittings	r 46,749	68,506	Japan 26,821; Italy 17,395; West Germany 6,988.
Castings and forgings, rough	3,832	4,176	United Kingdom 1,729; Japan 707; Belgium-Luxembourg 619.
Total	r 1,101,155	859,504	
Lead:			
Ore and concentrate	25,508	1,004	NA.
Oxides	31	125	United Kingdom 109.
Metal including alloys:			
Scrap	4,665	8,299	Canada 3,612; United States 2,648; Australia 372.
Unwrought	4,043	3,297	United Kingdom 10.
Semimanufactures	28	68	West Germany 6; United Kingdom 5.
Magnesium metal including alloys, all forms	519	576	United States 334; Norway 100; United Kingdom 96.
Manganese:			
Ore and concentrate	1,029	830	United Kingdom 633; Netherlands 128; Japan 20.
Oxides	846	1,323	Belgium-Luxembourg 766; Japan 270; United States 158.
Mercury ——76-pound flasks	1,825	2,370	U.S.S.R. 1,360; Spain 290; Japan 220.
Molybdenum metal including alloys, all forms	8	24	United States 16; United Kingdom 5; France 2.
Nickel metal including alloys, all forms	1,390	2,123	United Kingdom 464; West Germany 319; Japan 313.
Platinum-group metals including alloys, all forms ——troy ounces	r 32,188	71,392	United States 68,110; United Kingdom 2,051; West Germany 1,230.
Silicon and tellurium	385	60	Switzerland 48.
Silver:			
Waste and sweepings—troy ounces	r 34,828	5,168	NA.
Metal including alloys, all forms do	1,179,750	4,000,070	West Germany 3,573,940; United Kingdom 287,602; Australia 98,568.
Tin:			
Ore and concentrate	23	NA	
Oxides	23	14	United Kingdom 9; West Germany 5.
Metal:			
Scrap	3	23	NA.
Unwrought and semimanufactures	1,177	874	Brazil 14; United Kingdom 6.

See footnotes at end of table.

Table 3.—Republic of South Africa: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Titanium (ilmenite):			
Ore and concentrate	17,130	3	NA.
Oxides	602	71	United Kingdom 30; West Germany 26; Japan 15.
Tungsten:			
Ore and concentrate	539	422	Brazil 149; Canada 108.
Metal including alloys, all forms	71	83	Ireland 14; United Kingdom 2.
Zinc:			
Ore and concentrate	38,077	20,704	Mainly from Canada.
Oxides	400	386	West Germany 147; Portugal 60; United Kingdom 41.
Metal including alloys:			
Scrap, including powdered dust	604	306	Australia 22.
Unwrought	4,691	1,961	Japan 656; Australia 210; Italy 50.
Semimanufactures	384	49	United Kingdom 15; Belgium-Luxembourg 9; West Germany 7.
Zirconium ore and concentrate	41	49	All from Australia.
Other:			
Ores and concentrates:			
Molybdenum, tantalum, vanadium	r 258	76	Mainly from United States.
Other base metals	5,728	2,884	Mainly from Australia.
Ash and residue containing nonferrous metals	r 19,426	9,610	Australia 3,192; West Germany 1,330; Spain 988.
Oxides, hydroxides, peroxides of metals, n.e.s	351	346	United States 209; West Germany 41; Japan 31.
Elemental boron, phosphorus, selenium	100	104	United Kingdom 65; Canada 9; U.S.S.R. 2.
Metals including alloys, all forms:			
Alkali, alkaline earth, rare-earth metals	6,869	2,118	Austria 25; United Kingdom 20; West Germany 6.
Pyrophoric alloys	6	7	Japan 2; West Germany 1; United States 1.
Base metals including alloys, all forms, n.e.s.[1]	436	585	United Kingdom 172; Italy 69; Belgium-Luxembourg 63.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	4,956	6,331	United States 43; United Kingdom 20.
Grinding and polishing wheels and stones	669	570	United Kingdom 150; West Germany 109; United States 100.
Asbestos	30,385	28,560	Canada 2,743; Australia 500; United States 13.
Barite	4,684	2,718	West Germany 658; Israel 413; United Kingdom 142.
Boron materials:			
Crude natural borates	1,431	467	Netherlands 250; United States 163.
Acid	8,805	8,745	United States 6,345; Japan 82.
Bromine	32	6	NA.
Cement	84,691	70,307	United Kingdom 10,566; Japan 2,948; France 1,922.
Chalk	9,067	6,827	France 6,333; United Kingdom 358.
Clays and clay products:			
Crude clays and refractory minerals	29,488	16,234	United States 6,628; United Kingdom 3,436.
Products:			
Refractory	34,828	30,298	West Germany 13,321; Austria 4,407; United States 3,706.
Nonrefractory	8,682	2,779	West Germany 29.
Cryolite and chiolite	1,148	90	Denmark 84.
Diamond:			
Gem ——carats——	61,500	83,000	Belgium-Luxembourg 10,000; United Kingdom 10,000; Netherlands 2,000.
Industrial ——thousand carats——	7,741	9,044	United Kingdom 6,532; Ireland 962.

See footnotes at end of table.

Table 3.—Republic of South Africa: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Diatomite and other infusorial earth	8,805	8,745	United States 6,345; Japan 82.
Feldspar, leucite, nepheline syenite	1,159	95	NA.
Fertilizer materials:			
Crude:			
Nitrogenous	235	--	
Phosphatic	34	1,810	Israel 1,699.
Potassic	309,820	245,809	West Germany 64,791; Israel 37,737; France 16,761.
Other	6	1,534	NA.
Manufactured:			
Nitrogenous	78,436	136,449	Netherlands 47,955; Romania 43,060; West Germany 24,460.
Phosphatic:			
Thomas slag	1,795	--	
Other	8	375	NA.
Potassic	18,179	22,402	West Germany 12,122; United States 5,252; Canada 5,005.
Other, including mixed	917	1,086	Netherlands 855; Belgium-Luxembourg 190; West Germany 35.
Graphite, natural	557	894	Norway 340; United Kingdom 73; Sri Lanka 71.
Gypsum and plasters	6,179	5,616	West Germany 3,944; Spain 898; United Kingdom 696.
Lime	5,185	1,389	United States 772; France 100.
Lithium minerals, not further described	270	2,273	NA.
Magnesite	97,275	137,568	Japan 16,642; Italy 12,750; Australia 5,250.
Mica:			
Crude, including splittings and waste	357	423	West Germany 1.
Worked, including agglomerated splittings	73	50	United Kingdom 21; United States 11.
Pigments, mineral:			
Natural, crude	773	536	Austria 300; United Kingdom 167; West Germany 62.
Iron oxides, processed	4,961	2,208	West Germany 1,669; United Kingdom 196; Spain 70.
Precious and semiprecious stones, except diamond [2] —value, thousands	r $557	$2,059	Ireland $472; United Kingdom $138; United States $67.
Pyrite	34	31	NA.
Salt	16,594	48,491	Australia 46,264; United Kingdom 1,610.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	r 80,702	59,551	France 35,901; Belgium-Luxembourg 9,109; United Kingdom 8,619.
Caustic potash	2,140	1,228	West Germany 545; Czechoslovakia 284; France 216.
Stone, sand, and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	744	1,282	Italy 1,032.
Slate	--	38	NA.
Other	11,524	12,384	NA.
Worked	2,166	2,439	Italy 2,092; Portugal 119.
Dolomite	256	--	
Gravel and crushed stone	55,151	39,343	France 279.
Limestone	r 30,385	28,560	Canada 2,743; Australia 500; United States 13.
Quartz and quartzite	132	54	NA.
Sand, excluding metal bearing	924	289	United States 79.
Sulfur:			
Elemental:			
Other than colloidal	r 358,799	260,117	Canada 208,103; United States 23,250.
Colloidal	r 1,086	713	West Germany 597; United Kingdom 57.
Sulfur dioxide	2	2	NA.
Sulfuric acid	30	24,118	Japan 24,088; France 7.
Talc and steatite	3,304	1,654	Republic of Korea 509; Norway 491; United States 251.
Other:			
Crude	4,258	4,275	Greece 2,600; Australia 1,280.

See footnotes at end of table.

Table 3.—Republic of South Africa: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Other—Continued			
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture	28,072	32,225	All from Canada.
Slag and ash, n.e.s	239	36	United States 13.
Oxides and hydroxides of magnesium, strontium, barium	737	388	France 64.
Iodine and fluorine	17	3	All from Japan.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	3,959	2,113	Austria 670; Belgium-Luxembourg 546; United Kingdom 307.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	r 1,202	998	United States 257; Netherlands 91.
Carbon black and gas carbon	7,360	2,651	United States 1,293; Canada 536; United Kingdom 357.
Coal, all grades, including briquets	r 95,896	130,194	NA.
Coke and semicoke	212	--	
Gas, hydrocarbon, natural	81	35	NA.
Hydrogen and rare gases	66	36	United States 26.
Peat	256	394	West Germany 179; Netherlands 179.
Petroleum refinery products:			
Mineral jelly and wax 42-gallon barrels	383,806	236,641	West Germany 701; United States 534; Japan 138.
Bitumen and other residues_do	11,146	6,402	Netherlands 4,230; United States 2,146.
Bituminous mixtures, n.e.s _do	9,102	5,505	United States 4,327; United Kingdom 447.
Pitch _____do	11,061	14,740	Australia 12,718; United Kingdom 1,086.
Petroleum coke _____do	163,843	162,372	United States 112,181; United Kingdom 50,081.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	28	68	United States 22.

r Revised. NA Not available.
[1] Includes some manufactures not separated from unwrought and semimanufactures in source.
[2] Quantities not available; values reported in U.S. dollars, converted at the rates of 1.4722 rand=US$1.00 in 1974 and 1.3663 rand=US$1.00 in 1975.

Table 4.—Republic of South Africa: Value of domestic sales and exports of major mineral commodities

(Thousand dollars)

Commodity	Domestic sales		Exports	
	1975	1976	1975	1976
METALS				
Aluminum	50,250	55,828	18,445	17,480
Antimony	15,226	5,752	15,208	19,926
Chromium	16,701	25,537	r 39,118	44,430
Copper	75,319	64,933	124,581	132,630
Gold	(1)	(1)	3,498,268	2,737,196
Iron ore	25,848	31,050	31,693	60,853
Manganese	22,990	24,099	r 116,434	126,906
Nickel	12,204	14,830	71,991	77,883
Platinum-group metals	(1)	(1)	528,611	459,620
Silver	13,680	12,210	--	--
Tin	5,999	5,806	11,373	10,960
Uranium	(1)	(1)	52,281	70,315
Vanadium	1,048	8	51,921	57,195
Zinc	7,654	10,552	12,685	15,143
Zirconium	326	--	1,577	1,084
NONMETALS				
Andalusite	2,482	2,741	1,696	1,230
Asbestos	6,471	6,589	118,603	128,705
Carbon black	9,018	7,820	--	--
Cement	158,300	134,895	7,963	6,831

See footnotes at end of table.

Table 4.—Republic of South Africa: Value of domestic sales and exports of major mineral commodities—Continued

(Thousand dollars)

Commodity	Domestic sales		Exports	
	1975	1976	1975	1976
NONMETALS—Continued				
Diamond	(1)	(1)	238,039	247,334
Other gems	241	191	601	925
Feldspar	1,408	1,281	165	200
Fluorspar	1,481	1,616	9,194	15,954
Gypsum	2,178	1,822	238	164
Kaolin	1,476	1,600	17	37
Other clays	5,614	4,393	5,283	2,805
Limestone	27,240	27,911	r 139	109
Lime products	24,967	28,760	r 931	1,042
Magnesite	2,218	1,819	--	--
Mica	109	68	422	274
Phosphate	33,552	30,351	350	199
Pyrite	6,926	10,506	--	--
Salt	8,171	6,639	222	330
Shale	501	559	--	--
Silica	8,602	8,656	82	50
Silliminite	39	91	1,445	1,414
Slate	1,845	1,156	419	580
Stone	2,167	1,824	12,112	10,195
Talc	385	386	8	--
Vermiculite	218	183	7,732	7,000
Wonderstone	679	302	515	463
MINERAL FUELS AND RELATED MATERIALS				
Anthracite	13,223	12,844	24,846	34,395
Bituminous coal	r 367,767	463,658	26,186	84,546

r Revised.
1 Value, if any, is included under "Exports."

Sources: Republic of South Africa Department of Mines. Quarterly Information Circular, Minerals. October–December 1976.
U.S. Consulate General, Johannesburg, Republic of South Africa. State Department Airgram A–78, June 21, 1977.

COMMODITY REVIEW

METALS

Aluminum.—The country's production of aluminum metal continued to come from the Alusaf (Pty.) Ltd. refinery at Richard's Bay. Imports of alumina from the Swiss Aluminium Ltd. (Alusuisse) operation at Gove, Australia, increased from nearly 135,000 tons in 1975 to about 160,000 tons in 1976 and should have allowed the Alusaf plant (20% owned by Alusuisse) to reach its projected annual capacity of 78,000 tons of metal. Ingot prices at Richard's Bay increased from $963 to $1,216 per ton during the year owing to increased power and other in-plant costs. More than one-half of Alusaf's production was sold to Hullets Aluminium Ltd. (Hulamin) for its 40,000-ton-per-year Maritzburg plant, where modifications to increase efficiency and quality control reportedly continued on schedule. Hulamin produced flat and coil sheet, extruded forms, and cable, as well as aluminum paste for the paint industry.

The Republic of South Africa imported about 11,350 tons of aluminum metal products in 1976, compared with some 15,600 tons in 1975. More than 40% of the 1976 imports came from the United States. Australia remained the chief source of imported bauxite. Modest quantities of calcined or activated bauxite and alumina were imported for the chemical, refractory, and abrasives industries.

Antimony.—Consolidated Murchison Ltd. (CML) continued as the Republic's sole producer of antimony ore and concentrate. Production of ore from CML's mines north and northwest of Phalaborwa increased from 637,500 tons in 1975 to 642,800 tons in 1976; the equivalent antimony content of the ore decreased from 2.89% to 2.32%. Concentrate (plus cobbed ore) production declined from 26,160 tons in 1975 to 18,341

tons in 1976. Byproduct gold production declined from 3,300 troy ounces in 1975 to 2,700 troy ounces in 1976. Approximately 3,800 tons of high-arsenic concentrate containing about 1,100 tons of antimony was not included as production but was added to a stockpile of similar material for future treatment. Concentrate exports averaged nearly 2,000 tons per month from January to June largely to deplete the 6,000-ton stockpile, but decreased to slightly more than 1,000 tons per month during the last half of the year. Domestic sales also diminished in the latter part of the year.

Most of CML's local sales of concentrate went to the Antimony Products (Pty.) Ltd. plant on CML property at Gravelotte, where the sulfides were converted to trioxides used in the manufacture of a fire-retardant. This plant was being expanded, and a small plant for the extraction of precious metals from the slag was planned. CML completed a pilot plant for the treatment of high-arsenic concentrate and other products accumulated over several years.

Chromite.—Production of chromite increased 16% to 2.4 million tons in 1976. Domestic sales increased 45% to 804,000 tons, and exports dropped 34% to less than 600,000 tons. Increased mining activity and expansion of the ferrochrome production facilities reflected the industry's reaction to world demand and the national policy of enhancing commodity value by expanding domestic production of ferrochrome for export. Chrome sand production increased about 30% to nearly 700,000 tons, but for this commodity the market trends were reversed. Domestic sales decreased 50% to less than 100,000 tons, and exports increased 74% to nearly 600,000 tons. Despite the enhanced value of chromite on the world market, the Republic's mining and export capacities were not fully utilized because of the breakdown of loading facilities at the Mozambique harbor of Maputo. Loading facilities at Durban were temporarily increased to handle 400,000 tons annually but were to be abandoned when rail and loading facilities at Richard's Bay were available. Meanwhile, the Republic was prepared to allocate up to 1 million tons of chromite annually for export from Maputo, provided capacity and prompt loading facilities were available.

Copper.—Production of copper ore increased marginally, but with improved ore grades the output of concentrate and metal was about 10% higher than in 1975. Domestic sales improved marginally, but exports increased more than 25% to 127,000 tons. All four of the major copper producers reported financially satisfactory operations, partly owing to the higher rand equivalent of the world price for copper following devaluation of the rand in September 1975. The Messina (Transvaal) Development Co. Ltd. operation recovered from its 1975 loss with decreased operating costs and by treating a lower tonnage of ore at a higher grade than in 1975. Ore production by Prieska Copper Mines (Pty.) Ltd. (PCM) was about 5% greater and ore grade was about 10% lower than in 1975. Improved concentrator operations resulted in approximately 5% less concentrate with 10% higher copper content. PCM's return to profitability was largely owing to increased sales of zinc and pyrite concentrate, as copper production remained unchanged at 25,000 tons. Some of PCM's concentrate was smelted on a toll basis by O'okiep Copper Co. Ltd. near Springbok, 500 kilometers west of Prieska. O'okiep's production of ore, concentrate, and blister copper decreased slightly in 1976, but greater amounts of concentrates were bought or smelted on a toll basis, and output of blister copper increased from 38,843 tons in 1975 to 41,526 tons in 1976.

Expansion of the refinery at Palabora Mining Co. Ltd.'s open pit operation in the northeastern Transvaal was completed by yearend. Nearly 80 million tons of material, including almost 20 million tons of ore with an average copper content of 0.55%, was excavated during 1976. Nearly 260,000 tons of concentrate containing almost 95,000 tons of copper was produced, and the smelter output of nearly 105,000 tons of anode copper included 12,500 tons derived from concentrates purchased or treated on a toll basis. Refinery output increased from 70,600 tons in 1975 to more than 80,000 tons in 1976, including more than 8,000 tons treated on a toll basis. Palabora's byproducts include vermiculite, magnetite, zirconium-hafnium, and precious metals.

The following tabulation shows quantity, grade, and copper content of ores milled and quantity and grade of ore reserves de-

clared by the four major copper producers in 1976. Quantity and copper content are in metric tons, and grade is in percent copper.

Company	Ore milled			Ore reserves	
	Quantity	Grade	Metal content	Quantity	Grade
Messina	783,000	1.24	9,709	4,303,000	1.37
O'okiep	2,383,700	1.35	32,180	27,245,000	1.67
Prieska	2,620,000	1.12	29,344	48,000,000	1.74
Palabora	19,627,200	.55	107,950	300,000,000	.60
Total	25,413,900	.71	179,183	379,548,000	.83

Copper is an important constituent of South African platinum ores and, except for a small amount sent to Norway for extraction, is recovered as electrolytic cathode copper at domestic refineries. Output of copper by Rustenburg Platinum Mines Ltd. exceeded production by Messina during 1976.

The Phosphate Development Corp. Ltd. (FOSKOR) operation near the Palabora mine recovered 16,800 tons of copper sulfide concentrate containing about 35% or nearly 5,900 tons of copper. Smelting and refining was done at the Palabora plant, and the copper metal was sold by Rio Tinto Management Services, Palabora's marketing agency, on behalf of a FOSKOR subsidiary.

Exploration and feasibility studies of several cupriferous sulfide deposits in the northwestern part of Cape Province continued throughout 1976.

Gold.—Gold production dropped slightly from 22,937,850 troy ounces to 22,936,018 troy ounces in 1976. Declining world prices caused deactivation of some of the lower grade marginal mines, but many higher grade large producers continued to flourish. The average price realized by the South African gold industry declined from $148.45 per troy ounce in 1975 to $119.34 per troy ounce in 1976.[4]

Gold mines in the Witwatersrand region near Johannesburg produced nearly 701,300 kilograms (22.5 million troy ounces); the Barberton mines to the northeast accounted for 1,200 kilograms (38,600 troy ounces); and about 10,900 kilograms (351,000 troy ounces) came from small mines or was recovered as a byproduct of base metal ores. Production for 1975 and 1976 and proven reserves of various companies are shown in table 5.

Most South African mines produced their own bullion containing approximately 88% gold, 10% silver, and 2% base metals in bars weighing 25 to 27 kilograms (55 to 60 pounds). Rand Refinery Ltd. at Germiston assayed and purchased the bars on behalf of the South African Government's Reserve Bank, and payment was made to the mines within 5 days. The Refinery, with an annual capacity of 1,000 tons of gold and 100 tons of silver, produced 996-fine gold for coinage, 999-fine gold for industry and the arts, and electrolytically refined silver and platinum-group metals.

International Gold Corporation Ltd. (Intergold) arranged for gold sales to manufacturers, wholesalers, and retailers of gold products throughout the world. Sales of 1-troy-ounce Krugerrand coins dropped from about 4.7 million in 1975 to slightly more than 3.0 million in 1976, but sales of 2-rand coins increased from 108,000 to 172,000, mostly to distributors in West Germany and Switzerland, at a substantially higher premium than was realized on the Krugerrand.

Development work on the twin shafts at the Deelkraal mine near Carltonville, west of Johannesburg, progressed to nearly 1,000 meters each (3,200 and 3,250 feet). Ore reserves were estimated at 45 million tons at an average grade of 0.334 troy ounce per ton. At Anglo-American Corp. of South Africa Ltd.'s nearby Elandsrand property, shafts were at 1,300 and 800 meters (4,300 and 2,600 feet), and ore reserves were claimed to be 60 million tons at 0.379 troy ounce per ton. Surface installations were reportedly on schedule, and production was planned for 1981 at an estimated capital cost of more than $100 million for each mine. Anglo-American's plant for re-treatment of slimes from seven mines in Orange Free State was scheduled for startup in 1977, and a similar plant for 16 Transvaal mines was to commence operations in 1978. Annual output was expected to be some

[4] Chamber of Mines of South Africa Annual Report, 1976, p. 25.

Table 5.—Republic of South Africa: Gold production and ore reserves, by producer

Producer	Production (troy ounces)		1976 reserves [1]	
	1975	1976	Total (thousand metric tons)	Content (troy ounces per metric ton)
Barberton	47,133	38,578	NA	NA
Blyvooruitzicht	842,581	748,119	5,479	0.739
Bracken	259,437	239,099	1,700	.299
Buffelsfontein	942,158	945,518	7,028	.446
City Deep Consolidated Main Reef Crown Mines	127,146	93,816	NA	NA
Doornfontein	440,076	387,642	2,117	.456
Durban Deep	229,656	255,123	481	.235
East Daggafontein	57,637	69,809	NA	NA
East Driefontein	822,329	1,160,095	3,774	1.075
East Rand Proprietary Mines Ltd	366,136	354,639	1,150	.383
Freddies Consolidated	141,466	183,388	1,441	.412
Free State Geduld	1,215,423	1,115,746	6,514	.642
Free State Saaiplaas	157,992	121,109	2,452	.209
Grootvlei	165,303	180,282	2,700	.166
Harmony	989,857	976,482	13,779	.318
Hartebeestfontein	1,046,838	1,035,794	11,257	.437
Kinross	354,118	353,761	5,300	.299
Kloof	487,158	538,486	3,324	.540
Leslie	182,790	174,424	2,300	.225
Libanon	342,810	330,789	2,352	.469
Loraine	252,917	253,878	2,455	.410
Marievale	128,121	113,827	600	.187
President Brand	1,289,981	1,183,626	8,202	.478
President Steyn	869,067	914,615	10,642	.417
Randfontein	374,672	514,315	1,554	.685
St. Helena	812,784	841,179	9,300	.476
South African Land & Exploration Co. Ltd	165,136	171,257	NA	NA
Stilfontein	470,590	528,188	3,187	.437
Vaal Reefs	1,973,843	2,122,090	15,757	.472
Venterspost	233,331	223,210	5,237	.244
Vlakfontein	105,760	107,429	146	.460
Welkom	437,565	431,846	4,973	.355
West Driefontein	1,908,372	1,792,532	5,873	.859
West Rand Consolidated	204,514	167,743	1,333	.124
Western Areas	725,983	734,452	8,073	.276
Western Deep Levels	1,534,748	1,431,734	5,328	.632
Western Holdings	1,324,820	1,204,164	8,632	.596
Winkelhaak	477,766	502,072	6,700	.302
Witwatersrand Nigel Ltd	36,202	44,252	758	.254
Other	393,634	350,910	NA	NA
Total	22,937,850	22,936,018	171,898	.456

NA Not available.
[1] Fully developed and blocked-out ore only; calculated at gold prices between $125 and $130 per troy ounce and at current operating costs. Additional indicated and inferred (possible) reserves are not included.

200,000 troy ounces of gold, 180 tons of U_3O_8, substantial amounts of pyrite for sulfuric acid, and some copper.

The concentration of many of the world's deepest mines in a relatively small area near Johannesburg has resulted in the development, testing, and installation of improved techniques in mining, ventilation, temperature control, automation, and remote control of mine and plant operations, and monitoring of rock stress for improved mine safety. The South African Government's Department of Mines collaborated closely with the Chamber of Mines, the individual operators, and international equipment manufacturers in ongoing studies to improve efficiency and safety of mining operations.

Iron and Steel.—ISCOR, the Government-owned industrial giant, was the country's leading producer of iron ore and accounted for about 78% of the pig iron output and 72% of the rolled and drawn steel products output. The recently emerged SAMANCOR, partly owned but not controlled by the Government, was the leading producer of ferroalloys, accounting for about 32% of the country's total output during the year.

Iron Ore.—Production of hematite ore, particularly in the Sishen area, increased 30% from 9.4 million tons in 1975 to 12.2

million tons in 1976. Sishen ore continued to be stockpiled near the mine railhead until May 1976, when the Sishen-Saldanha Bay rail link was completed. Later, the ore was shipped to the 2.4-million-ton stockpile facility at the Saldanha Bay loading area. On September 23, loading of the 120,000-ton Norwegian ore carrier *Fernsea* started, and the ship commenced its maiden voyage on the following day. Outloading from Saldanha Bay during the remainder of the year was largely responsible for the increase in hematite exports from 2.5 million tons with a value of $26 million in 1975 to about 6.2 million tons worth approximately $60 million in 1976. The entire Sishen-Saldanha Bay operation was handled by ISCOR, and at yearend the value of hematite exports moving through the new port was estimated at about $10.2 million per month. Production, domestic sales, and exports increased during 1976 for both hematite and magnetite ores.

Production of liquid and pig iron increased 12% from 5.2 million tons to 5.8 million tons during 1976, and except for iron castings, increases were recorded in production of all other iron and steel products including ferroalloys. Exports of rolled and drawn steel products increased from 130,000 tons to more than 300,000 tons, while imports in this category declined from 740,000 tons to barely more than 300,000 tons because of expanded capacity of domestic plants. Reported production of ferroalloys is shown in the following tabulation, in tons:

	1975	1976
Ferrochrome	216,830	238,470
Ferromanganese	425,890	469,010
Ferrosilicon	104,580	115,220
Ferrovanadium	300	300
Total	747,600	823,000

Manganese.—Despite a decline of about 5% in total output, the Republic of South Africa remained the world's second largest producer of manganese ore (after the U.S.S.R.), and the largest exporter among market economy countries. Most of the output came from the Postmasburg and Sishen areas in the northern part of Cape Province where transport facilities were improved by the completion of the railroad to the newly commissioned ore port at Saldanha Bay. Proved ore reserves in this area were reported at 2.37 billion tons, and resources were estimated at 10 times this figure. SAMANCOR accounted for about 65% of the country's manganese ore output from its Hotazel, Mamatwan, and Lohatla open pits and the Wessels underground mine. A new inclined shaft to double the 250,000-ton-per-year capacity at Wessels was scheduled for completion in 1977. SAMANCOR's ores for export were shipped 800 kilometers by rail to Port Elizabeth during 1976. The second largest producer, Associated Manganese Mines of South Africa Ltd., started expansion of open pit operations near Kuruman in northern Cape Province and planned expanding the Feralloy Ltd. plant operated by a sister company in the Transvaal.

Exports and domestic sales of manganese ores increased marginally in volume, but their value increased more than 25% in terms of domestic currency.

Nickel.—Electrolytically refined nickel was a byproduct of South African platinum mines. The 1976 mine output of 22,371 tons of metal content was the highest yet recorded, although it was only about 8% more than the 1975 production. About 85% of the nickel production was exported, and the stainless steel industry was the largest domestic consumer.

Platinum-Group Metals.—The Republic of South Africa accounted for 45% of the world's production of platinum-group metals in 1976 and ranked first in the production of platinum. Most of the 2.7 million troy ounces of platinum-group metals was extracted from 14.2 million tons of ore handled by four mining companies operating on the Merensky Reef. This represented an increase of about 4% over the 1975 output of 2.6 million troy ounces from 13.4 million tons of ore. Platinoids from the Merensky Reef had a platinum-palladium ratio of about 2.3:1, compared with byproducts of Canadian copper-nickel ores with about equal parts of platinum and palladium and Soviet platinoids that reportedly include more than twice as much palladium as platinum.

Approximately 6,000 troy ounces of byproduct platinoids from the Witwatersrand gold mines consisted largely of iridium and osmium, the heaviest and hardest of the platinum-group metals. Tankhouse residues from the Palabora copper refinery con-

tained nearly 3,000 troy ounces of the platinum-group elements.

Tin.—Output of cassiterite concentrate was virtually unchanged for 1976, but the metal content improved, averaging 49.5% tin compared with 46.8% in 1975. Tin metal production continued to decline from 780 tons in 1975 to 683 tons in 1976. Gold Fields of South Africa Ltd. was the parent company of Union Tin Mines Ltd., whose operations were being phased out because of declining grade, and of Rooiberg Minerals Development Co. Ltd., which experienced metallurgical problems but continued underground development. Zaaiplaats Tin Mining Co. Ltd. continued both mining and custom-smelting operations.

Uranium.—Production of uranium peaked at 5,847 tons of U_3O_8 in 1959 and again at 3,800 tons in 1971. A subsequent downward trend to 2,934 tons in 1975 was reversed in 1976 when 3,254 tons of U_3O_8 was produced, 3,111 tons of this by Witwatersrand gold mines. Output from the Palabora copper operation increased from 125 tons to 143 tons during 1976. Anglo-American on August 3, 1976, officially opened its plant to recover uranium, pyrites (for an associated sulfuric acid plant), and gold by re-treating tailings from seven mines in Orange Free State. Three supplementary flotation plants were to be added to the complex in 1977, and a similar plant to treat old tailings at abandoned mines in the Transvaal was scheduled to start operations in 1978. Installation or reactivation of uranium recovery equipment at other gold mines was also contemplated if world demand and prices warrant.

Except for Palabora, all South African uranium producers sold through the Nuclear Fuels Corporation (NUFCOR), which reportedly renegotiated higher contract prices for its products with the United Kingdom, West Germany, and Japan during 1976. It was estimated that about 2,600 tons of U_3O_8 valued at about $70 million was exported in 1976, a notable increase over the 2,348 tons valued at some $58 million estimated for 1975. NUFCOR also supplied raw material to the Government-owned Uranium Enrichment Corporation's (UCOR) pilot plant, which increased the percentage of U_{235} from its natural level of 0.7% to the 3.5% needed as fuel in nuclear powerplants. UCOR announced that the pilot plant was successful and that construction of a full-scale plant with a capacity of 5,000 tons of product per year was planned. The cost of such enrichment at full-scale operation was expected to be about 25% lower than the 1980 projected price for enrichment elsewhere. Exploration activity in the Karroo Basin of Cape Province was reportedly accelerated during 1976 by several firms. The opening of a uranium mine in this area by 1985 was predicted.

Vanadium.—Nearly one-half of the vanadium from market economy countries was produced in the Republic of South Africa from titaniferous magnetite deposits in the prolific Bushveld Igneous Complex of the northern Transvaal. Highveld Steel and Vanadium Corp. Ltd. and Ucar Minerals Corp. operated open pit mines, and Transvaal Alloys (Pty.) Ltd. used stockpiled ore to produce vanadium pentoxide (V_2O_5). Highveld produced V_2O_5, two grades of ferrovanadium, and slag containing 25% V_2O_5. Ucar's products included V_2O_5, metavanadate (V_2O_3), and Carvan (vanadium carbide). The total V_2O_5 equivalent of these products was reported at 17,600 tons in 1976, a drop of 7% from the 19,000 tons reported for 1975.

Zinc and Lead.—PCM, a subsidiary of Anglo-Transvaal Consolidated Investment Co. Ltd., accounted for the country's zinc output in 1976. The mine and concentrator in east-central Cape Province handled more than 2.2 million tons of ore with an average grade of 3.55% zinc (plus 1.12% copper) and produced nearly 150,000 tons of zinc sulfide concentrate with 52.4% zinc, an increase of 17.5% over the 1975 output of about 128,000 tons with 51.9% zinc. Because of the relatively stable price of zinc and the depressed copper price, PCM's zinc output accounted for the company's profitability in 1976. PCM also produced more than 90,000 tons of copper sulfide and nearly 1,800 tons of lead concentrate and increased its production of pyrite (for sulfuric acid) from 75,000 tons in 1975 to nearly 160,000 tons in 1976. Part of PCM's concentrate was sold to Gold Fields' subsidiary, Zinc Corporation of South Africa Ltd. (ZINCOR), and most of the remaining 86,000 tons of concentrate was exported to West Germany. ZINCOR's output of 66,200 tons of electrolytically refined zinc was derived in part from concentrate imported from Canada.

Exploration of several large lead-zinc-copper deposits in the northwestern part of Cape Province continued throughout the year. Feasibility studies of one deposit near Aggeneys indicated a 38-million-ton ore body with 6.35% lead, 2.85% zinc, 0.45% copper, and 2.6 troy ounces of silver per ton. Development as an underground mine appeared to involve considerably lower capital cost than starting as an open pit operation.

NONMETALS

Asbestos.—Increases were recorded in output, domestic sales, and exports of chrysotile and Cape blue crocidolite asbestos during 1976, and overall production rose from nearly 355,000 tons in 1975 to about 370,000 tons in 1976. Domestic sales were reportedly about 10% of production, but exports were estimated at 690,000 tons. Neither stockpiling nor the import volume, reported at 30,000 tons, accounted for the discrepancy between output and export volume.

Cement and Limestone.—The construction industry reflected the cautious reaction of other major industries in curtailing unnecessary expansion during the period following local currency devaluation. The output and domestic sales of limestone, burnt lime, and cement remained virtually unchanged. Of the 17 million tons of limestone produced, nearly 14 million tons was reported as sold locally. The cement industry consumed nearly 10 million tons of limestone (and nearly 400,000 tons of shale), about 1.5 million tons was calcined into lime, 1.7 million tons went to the metallurgical industries, and 1.4 million tons went to agriculture. Imports and exports of limestone and lime were insignificant, but about 300,000 tons of cement was exported.

Diamond.—Output of diamond at 7.0 million carats was 4% lower than the nearly 7.3 million carats reported in 1975. Sales decreased from more than 8 million carats to 7.6 million carats, but the value increased from $238 million to more than $247 million. Worldwide demand for small gem stones strengthened, and De Beers' Central Selling Organization increased prices 3% in January and 5.75% in September. Worldwide sales of gem diamond through the Central Selling Organization amounted to $1,524 million (R1,325 million), an increase of 46% over those of 1975 in terms of U.S. dollars and 70% in terms of rands.

DeBeers Consolidated Mines Ltd.'s Finsch mine in eastern Cape Province was the largest producer with 2.20 million carats, down from the 2.29 million carats produced in 1975. Output from the Premier mine in the Transvaal decreased from 2.04 million carats to 1.83 million carats.

Table 6 shows the marketed output of diamond and the U.S. dollar equivalent of average prices realized from various South African sources.

Fertilizer Materials.—*Phosphate.*—Production of crude phosphate ore set a record high of nearly 12.4 million tons, a 6.3% increase over the previous high of 11.6 million tons reported for 1975. Domestic sales of crude ore and concentrate increased to 109,000 tons and 1.6 million tons, respectively, and exports declined from 13,230 tons to 11,120 tons of contained P_2O_5. FOSKOR was the country's largest producer from its open pit mine in the apatite-rich "ring" surrounding Palabora's carbonatite

Table 6.—Republic of South Africa: Marketed diamond output, by province

Province	1975		1976	
	Output (carats)	Price per carat	Output (carats)	Price per carat
Mine diamond:				
Transvaal	2,413,380	$9.78	2,083,709	$11.55
Cape Province	3,771,586	22.61	3,642,727	22.95
Orange Free State	470,087	38.28	408.942	52.84
Total	6,655,053	19.06	6,135,378	21.07
Alluvial diamond:				
Transvaal	12,590	98.08	10,784	104.16
Cape Province	1,344,897	81.73	1,404,959	83.22
Orange Free State	91	93.46	61	207.38
Total	1,357,578	81.88	1,415,804	83,38
Grand total	8,012,631	29.71	7,551,182	32.75

deposit. Approximately 40% of FOSKOR's mill feed was tailings pumped directly from the Palabora concentrator. FOSKOR's ore also contains copper, iron, and zirconium minerals marketed by a subsidiary company. FOSKOR was the largest phosphate producer with nearly 1.4 million tons of P_2O_5 in concentrate, followed by SAMANCOR with 230,000 tons and Gold Fields' Glenover operation with nearly 109,000 tons. Transport and railcar shortages restricted both domestic sales and exports.

Fluorspar.—The Republic's potential as a major supplier of fluorspar was demonstrated by an overall increase of about 44% in output from nearly 203,000 tons in 1975 to almost 291,000 tons in 1976. Domestic sales of metallurgical grades increased from nearly 15,000 tons to more than 25,000 tons, and exports of all grades increased from about 126,500 tons to 229,000 tons. The newly completed operation at Marico in the Transvaal had a steadily increasing output during the year and, with a capacity of 120,000 tons of acid-grade and 50,000 tons of metallurgical-grade fluorspar per year, was expected to boost the country's exports to the 300,000-ton mark in 1977–78.

MINERAL FUELS

Coal.—Most of the country's electrical energy was derived from thermal powerplants that consumed nearly 60% of the output of its extensive coal deposits. About 13% of the coal output was of sufficient quality for the production of coke, chiefly for metallurgical industries. During 1976, an effort was made to import high-quality coking coal and export larger quantities of steam coal; in April, a coal export facility was commissioned at Richard's Bay. Total output of coal increased 11% to 77.1 million tons; increases were recorded in all categories, as shown in table 7.

Bituminous and subbituminous coal accounted for 97% of the total value of domestic sales but only 71% of the total value of exports of all types of coal; the remaining 26% of exports consisted of more than 1.5 million tons of Natal anthracite. Of the domestically consumed coal, 41.2 million tons or 58% was burned to produce electricity; 9.2 million tons or 13% was used to produce 4.7 million tons of coke; 12% went to local industries; 5% was for household consumption; 3% went to produce coal gas; 2% (nearly 1.5 million tons) each went to other gas producers, the oil-from-coal project, consumption at coal mines, and for transport; and 1% was consumed at other mines.

SASOL announced that a new company, Sasol (Transvaal) Ltd., would own and operate the Secunda oil-from-coal works under SASOL's management, and the mine at Secunda, near Trichardt, will remain a SASOL activity. Plant site preparation began in July 1976, a railroad line was under construction, and mechanical construction was scheduled to start by mid-1977.

Petroleum.—Imports of crude oil for South African refineries decreased from 122.5 million barrels (U.S. 42-gallon barrels) in 1975 to 116 million barrels in 1976. The SASOL oil-from-coal conversion plant produced 4,375,000 barrels of synthetic crude petroleum.

On December 17, 1976, the Department of Mines announced that significant amounts of oil had been discovered in an offshore well in the Agulhas Bank area, 61 kilometers south of Stilbaai between Cape Agulhas and Mossel Bay. The oil reportedly occurred in a massive, tightly cemented sandstone bed with a 55% maximum satu-

Table 7.—Republic of South Africa: Coal production, local sales, and exports
(Thousand metric tons and thousand dollars)

	1975		1976	
	Quantity	Value	Quantity	Value
Bituminous and subbituminous:				
Production	67,849	NA	74,600	NA
Sales	65,732	r 367,767	68,987	463,658
Exports	1,565	26,186	4,431	84,546
Anthracite:				
Production	1,591	NA	2,459	NA
Sales	701	13,223	773	12,844
Exports	1,122	24,846	1,530	34,395

r Revised. NA Not available.

ration level and low porosity and permeability that could preclude economic recovery. Limited quantities of natural gas were also reported. The well was the second in a series of holes scheduled for a 2-year period at a cost of $60 million, provided by the Government-owned Southern Oil Exploration Corp. Pty. Ltd. (SOEKOR). Drilling was done by a Sedco K floating unit operated by Southeastern Drilling Company (SEDCO) of Dallas, Tex., under contract to SOEKOR.

The Mineral Industry of the Territory of South-West Africa

By Candice Stevens [1]

The mineral industry of the Territory of South-West Africa contributed approximately 44% to the 1976 gross domestic product (GDP) estimated at $650 million.[2] The major minerals produced were diamond ($170 million), copper ($60 million), lead ($20 million), and other base metals ($36 million). Two firms, Consolidated Diamond Mines of South-West Africa Ltd. (CDM) and Tsumeb Corporation Ltd., accounted for nearly 90% of the value of mineral output. It was predicted that Rössing Uranium Ltd.'s uranium mine, scheduled to begin full production in 1978, would bring a return exceeding that of the diamond industry and increase the contribution of the mineral sector to 65% of the GDP.

In general, mining activity in 1976 was at low levels because of both falling metal prices and political uncertainties. Tsumeb closed two mines during the year resulting in a 30% decrease in the value of metal sales by the company. The startup of full production at both the Rössing uranium mine and Otjihase Mining Co. (Pty.) Ltd.'s copper mine was deferred owing to technical difficulties. Although new prospects were indicated in uranium and diamond, exploration for other minerals showed an overall decline. In the petroleum sector, exploration ceased both on- and offshore as additional companies relinquished their concession areas.

Negotiations continued throughout 1976 at the Turnhalle Conference regarding the structure of an interim government to be established prior to the Territory's independence, targeted for December 31, 1978. Among the questions to be decided were future policy concerning the Territory's commercial and economic resources and the status of Walvis Bay, the only deepwater port in the Territory. Legislation was introduced in 1976 to transfer the administration of Walvis Bay back to the Republic of South Africa, which had held ownership rights to the port since 1884.

The Republic of South Africa made a large investment in the Ruacana Falls hydroelectric scheme, a prospective source of power for the Territory's mineral industry. The $280 million project, involving the construction of a series of dams, hydroelectric plants, irrigation facilities, and canals along the Cunene River on the Angolan border, was the result of an agreement signed in 1969 between the Republic of South Africa and Portugal. Two major segments of the project, the Gove regulating dam and the Calueque pumping station, were completed in 1976. Three of the four generating sets at the Ruacana power station were scheduled to be commissioned in mid-1978. However, all construction ceased in September 1976 owing to a political dispute between Angolan and South African authorities.

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[1] Economist, International Data and Analysis.
[2] Where necessary, values have been converted from South African rand (R) to U.S. dollars at the rate of R1 = US$1.15. The rate in 1975 was R1 = US$1.3663.

PRODUCTION AND TRADE

The South-West Africa Administration, Republic of South Africa, continued its policy of not disclosing mineral production statistics for the Territory. Most of the statistical data on production of mineral commodities listed in table 1 were derived from the annual reports of the companies operating in the Territory, primarily Tsumeb, CDM, and the South-West Africa Co., Ltd. (SWACO). Although the Territory traditionally produces a variety of other minerals, particularly nonmetals, output data are not available and these commodities are not listed in table 1.

Production of most minerals declined in 1976. Copper production at the major mines of Tsumeb, Oamites, and Otjihase was at low levels. The output of Tsumeb's other products—arsenic, cadmium, and silver—also decreased. Similarly, tungsten and lead-zinc production and diamond recovery decreased slightly.

The Territory's foreign trade in mineral commodities was included in the trade statistics of the Republic of South Africa and was not differentiated. It was estimated that minerals accounted for approximately 60% of the value of total exports of the Territory in 1976. Diamond, which was marketed by De Beers Consolidated Mines Ltd., constituted about 66% of total mineral exports. All metals produced by Tsumeb, which contributed about 20% of mineral exports, were transported on a 640-kilometer company-owned railroad to Tsumeb's loading facilities at Walvis Bay. Copper and lead were exported as blister copper and refined lead; zinc was shipped as concentrate for refining elsewhere. Tsumeb also imported lead concentrate from the United States for refining and reexport.

Table 1.—Territory of South-West Africa: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS [2]			
Arsenic, white [3]	6,640	6,663	[e] 6,660
Cadmium:			
Mine output, metal content, recoverable	126	118	[e] 110
Metal, refined	114	102	83
Copper:			
Mine output, metal content, recoverable [4]	32,478	39,034	36,000
Metal, blister	46,612	36,410	21,900
Lead:			
Mine output, metal content, recoverable	56,761	48,300	42,200
Metal, refined	64,342	44,300	39,600
Silver:			
Mine output, metal content, recoverable [5] thousand troy ounces	1,904	1,823	1,401
Smelter output, content of blister copper ——do	2,395	2,077	[e] 1,250
Tin, mine output, metal content, recoverable	781	760	800
Tungsten, mine output, metal content, recoverable	[r] 155	[r e] 160	[e] 140
Uranium, U_3O_8 content	—	—	700
Vanadium, mine output, metal content	819	562	[e] 700
Zinc, mine output, metal content [6]	[r] 47,186	43,251	41,308
NONMETALS			
Diamond: [7]			
Gem ——thousand carats	1,491	1,660	1,609
Industrial ——do	79	88	85
Total ——do	1,570	1,748	1,694
Lithium minerals [8]	37,762	51,573	5,915
Pyrite concentrates, gross weight	9,566	9,643	[e] 9,200
Salt	209,000	[e] 210,000	[e] 220,000
Sulfur, content of pyrite	4,480	4,455	[e] 4,000
Wollastonite	1,000	NA	NA

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, the Territory of South-West Africa, prior to 1967, produced bismuth concentrate, cesium ore, columbite-tantalite concentrates, gold, manganese ore, molybdenum concentrate, graphite, lime, mica, precious stones, kyanite, sillimanite, and a variety of crude construction materials (clays, stone, sand and gravel). No official statistics have been published since yearend 1966, and available information is inadequate to ascertain whether production has continued or not, and if so, at what levels.

[2] Data are compiled from operating company reports as follows: Tsumeb Corp. Ltd. (arsenic, mine and refined cadmium, mine and blister copper, mine and refined lead, mine and smelter silver, mine zinc, and pyrite concentrate); South-West Africa Co. Ltd. (SWACO) (mine lead, mine tin, mine tungsten, mine vanadium, and mine zinc); South African Iron and Steel Industrial Corporation Ltd. (ISCOR) for Imcor Zinc (Pty.) Ltd.'s Rosh Pinah mine (mine lead and mine zinc), and for ISCOR's own Uis mine (mine tin); General Mining & Finance Corp. Ltd. (Republic of South Africa) for Klein Aub Koper Maatskappy Ltd.'s mine near Rehoboth (mine copper and mine silver); and Falconbridge Nickel Mines Ltd. (Canada) for Oamites Mining Co. (Pty.) Ltd.'s Oamites mine (mine copper). Data from Tsumeb and Falconbridge are for calendar years; data from other companies are for fiscal years ending June 30 of the year stated.

[3] White arsenic equivalent of all arsenic products reported as being produced.

[4] Figures comprise reported production of Tsumeb and Oamites plus an estimate for Klein Aub for 1974, 1975, and 1976, and an estimate for the Republic of South Africa's Johannesburg Consolidated Investment Co. Ltd. (JCI) (Otjihase copper mine) for 1975 and 1976.

[5] Figures comprise reported production of Tsumeb for 1974 and 1975, plus estimates for Oamites and Klein Aub.

[6] Figures comprise reported production of ISCOR for Imcor's Rosh Pinah mine plus estimates for Tsumeb (based on ore milled) as well as for SWACO for 1976.

[7] Total figures reported by De Beers Consolidated Mines Ltd. in company annual reports for calendar years; detail on gem and industrial diamonds are estimates, assuming output to be 95% gem quality.

[8] Output has not been officially reported since 1966, but presumably has continued since a number of countries record imports from "South Africa", which in total quantity considerably exceed reported output of the Republic of South Africa proper, and presumably include shipments from the Territory. Quantities given represent imports of the United States and the European Communities reported as originating in the Republic of South Africa, but the reader is cautioned that a portion of the material may have been mined in Southern Rhodesia.

COMMODITY REVIEW

METALS

Tsumeb continued in 1976 as the Territory's largest producer of nonferrous metals, principally copper, lead, zinc, silver, cadmium, and arsenic. The closure of two mines during the year caused total metal sales to decrease from $75 million in 1975 to $52 million in 1976. However, Tsumeb lowered its net loss in 1976 to approximately $2 million from the $3 million deficit in 1975. Newmont Mining Corporation (United States) was the manager and a principal shareholder (29.6%) of Tsumeb, whose other owners included AMAX Inc. (29.6%), Selection Trust Ltd. of the United Kingdom (14.2%), O'okiep Copper Co. Ltd. of the Republic of South Africa (9.5%), Union Corporation Ltd. of the Republic of South Africa (9.4%), and SWACO (2.4%).

Tsumeb has traditionally accounted for about 80% of the nonferrous metal production in the Territory through its mine at Tsumeb (located 400 kilometers north of Windhoek), the nearby Kombat and Asis mines, and the Matchless mine (located 42 kilometers south of Windhoek). In 1976, the Tsumeb mine, the largest of the ore bodies, milled 443,000 tons of ore grading 4.25% copper, 9.04% lead, and 2.39% zinc. The Matchless mine milled 102,000 tons of ore grading 2.40% copper. In March 1976, the Kombat and Asis Ost mines suspended operations because of low metal prices and the need to shift to the development of a new ore body at Asis West. Prior to the suspension, the two mines milled 60,000 tons of ore grading 1.49% copper and 1.92% lead. Both the Kombat mine and the Asis Ost mine, a joint venture of Tsumeb (75%) and SWACO (25%), were scheduled to resume operations in 1978.

Development drilling continued during 1976 at the Asis West mine, located immediately west of the Kombat mining district. The main mine shaft at Kombat was deepened and the lower levels extended in order to gain access to the Asis West reserves. Estimates of reserves at the new mine increased the tonnage to 1.4 million tons grading 7.78% copper and 4.33% lead. Production at Asis West, under the joint ownership of Tsumeb (85%) and SWACO (15%), was scheduled to begin in late 1978.

Smelter production at Tsumeb in 1976 was 21,900 tons of copper, including 7,500 tons of custom-smelted metal, and 39,600 tons of lead, including 5,100 tons of custom-smelted metal. Both copper and lead output decreased from the 1975 levels of 36,410 tons and 44,272 tons, respectively. During 1976, a total of 2,000 tons of zinc metal contained in concentrates was exported from Walvis Bay for overseas smelting and refining. Tsumeb and O'okiep continued to cooperate on the currently suspended joint venture, Cape Copper Refinery, aimed at refining the copper output of the smaller producers in the Territory and the Republic of South Africa.

Copper.—The other major copper producer in addition to Tsumeb was Oamites Mining Co. (Pty.) Ltd., a joint venture of Falconbridge Nickel Mines Ltd. (Canada) (74.9%) and International Development Corp. (IDC) of the Republic of South Africa (25.1%). The Oamites mine, located 55 kilometers south of Windhoek, milled over 600,000 tons of ore in 1976 compared with 568,000 tons in 1975. However, recoverable copper output decreased from 6,852 tons in 1975 to 6,384 tons in 1976 because of the lower grade of ore. Mine development during the year involved completion of underground ore transportation facilities and a crushing station, plant improvements, and the addition of new employee accommodations. Reserves at yearend 1976 were estimated at 4.05 million tons grading 1.21% copper and 0.54 troy ounce of silver per ton. Production statistics for the Oamites mine for 1975 and 1976 follow:

	1975	1976
Ore milled ----metric tons--	568,000	601,000
Mill-head grade -percent Cu--	1.13	1.14
Mill recovery -----percent--	93.40	92.99
Concentrates produced dry tons--	19,000	20,000
Recoverable copper metric tons--	6,852	6,384

Production at the mine owned by Klein Aub Koper Maatskappy Ltd., a subsidiary of General Mining & Finance Corp. Ltd.

(Republic of South Africa), remained at the 1975 level of approximately 9,000 tons of concentrates. Total ore reserves were reported at 8 million tons of copper-silver ore grading 2.5% copper. The company planned to expand production at the mine and possibly exploit additional deposits at Okasewa.

The Otjihase copper mine, which came onstream in October 1975, suffered financial losses in 1976 as a result of a combination of production problems and low metal prices. In addition, a new smelter that was opened at Tsumeb in 1976 to handle Otjihase concentrates incurred serious technical problems. As a result of the difficulties encountered underground, the tonnage milled did not attain the target rate of 100,000 tons per month. In 1976, approximately 430,000 tons of ore was milled and 30,000 tons of 22% copper concentrates was produced. In addition to copper, important quantities of precious metals were recovered at the refining stage, and approximately 35,000 tons of pyrite concentrates was sold on a contractual basis to Rössing. The Otjihase mine, situated 27 kilometers northeast of Windhoek, was brought into production at a cost of $48 million. The major shareholder was Johannesburg Consolidated Investment Co., Ltd. (JCI) (52.5%). The remaining shares were held by Minerts Development (Pty.) Ltd., owned equally by Fedmar Ltd. (Republic of South Africa) and Continental Ore Corp. (United States).

Navarro Exploration Co., a wholly-owned subsidiary of Zapata Heron, Inc. (United States), continued to operate its small copper mine and mill at Onganja, located near Okahandja north of Windhoek. Milling capacity at Onganja, opened in 1973, was estimated at 200 tons per day. Reserves were estimated at 320,000 tons with an average grade of 2.7% copper.

Lead, Zinc, Vanadium.—The major producer of lead, zinc, and vanadium was the Berg Aukas mine, operated by SWACO. Milling capacity was 125,000 tons per year, leading to an average production of 40,000 tons of concentrates. Output was composed of lead vanadates, zinc sulfide, lead sulfide, and zinc silicates. The company continued development activity, including shaft deepening and dewatering operations, in 1976.

The other major lead-zinc producer in the Territory was the Rosh Pinah mine, operated by Imcor Zinc (Pty.) Ltd., a subsidiary of the South African Iron and Steel Industrial Corporation Ltd. (ISCOR). In 1976, zinc concentrate production decreased from 27,100 tons in 1975 to 25,030 tons with a zinc metal content of 50.6%. The total output of zinc concentrates was processed at Zinc Corp. of South Africa Ltd.'s (ZINCOR) electrolytic refinery near Springs, Republic of South Africa. Lead concentrate production, which was marketed in the Territory, increased from 5,288 tons in 1975 to 7,023 tons in 1976. Reserves at the original underground mine at Rosh Pinah, located in the Namib Desert about 27 kilometers north of the Orange River, were completely exhausted during 1976, and operations were switched to the new open pit mine without any loss in production.

Tin and Tungsten.—The Territory's major tin producer was the Uis tin mine, operated by Industrial Minerals Corp. (Pty.) Ltd., a wholly-owned subsidiary of ISCOR. Its production decreased slightly from 1,177 tons of tin concentrate (with a tin metal content of 64.6%) in 1975 to 1,262 tons of tin concentrate (with a tin metal content of 63.4%) in 1976. Output from the Uis mine, located northeast of Swakopmund near Brandberg, was shipped to ISCOR's smelting plant at Vanderbijlpark Steel Works in the Republic of South Africa.

SWACO continued trial operations at its Brandberg West tin-tungsten mine in 1976. Operations were suspended in 1973, but overburden stripping and plant rehabilitation were resumed a few years later. Reserves were estimated at 6.6 million tons grading 0.24% combined tin and tungsten.

Tungsten was the main product at the Krantzberg tungsten mine, owned by Nord Resources Corp. (United States) (40%) and Ebco Mining Co. (60%), a subsidiary of Bethlehem Steel Corp. (United States). Nord served as operator and marketed all output of the Nordex Joint Venture Ltd. Although the price of tungsten increased significantly during 1976, equipment breakdowns and a reduction in ore grade resulted in net losses for the year. Krantzberg's production capacity of concentrate was rated at 7,500 tons per year, but the plant was reported as operating at half

of capacity for most of the year. Substantial mill modifications and repairs were made in the latter part of 1976, and mining commenced in the new "C" ore zone. An improvement in operating results in 1977 was expected at the Krantzberg mine, situated northwest of Windhoek near Omaruru.

Uranium.—The large uranium mine operated by Rössing came onstream in mid-1976 with annual production totaling 850 tons of U_3O_8. Rössing originally planned to achieve full capacity of 5,000 tons of U_3O_8 per year by the first half of 1977. However, because of technical problems in the treatment plant, full design output will not be achieved until mid-1978, a delay of 18 months. Rössing encountered another problem in November 1976 when it was hit by a brief strike by approximately 500 of its 1,500-employee work force. Production at the plant was maintained by utilizing stockpiled ore.

The large, low-grade (0.04%) uranium ore body, situated 70 kilometers northeast of Swakopmund, has been under development since 1966. The latest estimate of reserves was 150,000 tons of uranium oxide. Scheduled to become one of the largest uranium mines in the world when full production is reached, the Rössing mine's initial cost was estimated at $210 million. The initial mining rate of ore and waste from the open pit was 60,000 tons per day, scheduled to increase to 120,000 tons per day by 1980. An underground mining section was also under development and was scheduled to be in operation in the second half of 1977.

The largest shareholder in the Rössing venture was Rio Tinto-Zinc Corporation Ltd. of the United Kingdom (42.5%). Also holding interest in the mine were IDC, General Mining, and Total Compagnie Minière et Nucleaire (France). The delays in production necessitated a renegotiation of Rössing's uranium supply contracts. Shipments to the United Kingdom Atomic Energy Commission, which contracted to receive 7,500 tons of uranium oxide between 1977 and 1982, were deferred. Although individual buyers were not divulged under the South African Atomic Energy Acts, the balance of production was to be marketed in Western Europe and Japan.

Several other companies were active in the search for uranium in the areas north and east of Swakopmund. General Mining reported the discovery of uranium in two extensive layers of calcrete at Langer Heinrich mountain near Tinkes, east of Swakopmund. A feasibility study completed in 1976 indicated that a profitable mining venture could be undertaken; marketing and financing investigations were in progress.

Anglo-American Corp. of South Africa Ltd. planned to put increased emphasis on its uranium exploration activities in the Territory. Investigations were being conducted in the Karoo region in conjunction with Empresa Nacional del Uranio S.A. (ENUSA), a Spanish nuclear fuel company. Exploration was also underway in the Swakopmund and Lüderitz areas in conjunction with Minatome S.A. (Japan), Union Corporation, and Société Nationale des Pétroles d'Aquitaine (France).

Gold Fields of South Africa Ltd. was conducting studies of a large deposit discovered at Trekkopje, adjacent to the Rössing property. Other companies involved in uranium prospecting in the Territory included JCI and Falconbridge.

NONMETALS

Diamond.—The largest contributor to the nation's mineral industry was CDM, a company noted for its production of virtually all gem stones. The 1976 output of CDM, a wholly-owned subsidiary of De Beers Consolidated Mines Ltd., represented 16% of De Beers' total production. The tonnage treated at Oranjemund increased from 12.25 million tons in 1975 to 12.88 million tons in 1976, but the grade decreased from 0.1427 carat to 0.1315 carat per ton. Final diamond recovery decreased from 1.75 million carats in 1975 to 1.69 million carats in 1976. Although total carats recovered showed a decrease, the average stone size increased from 0.73 carat in 1975 to 0.95 carat in 1976.

CDM has surface-mined marine terraces since 1920 in its 8,000-square-kilometer tract that stretches along the coast from the Orange River to Lüderitz. In the 1970's, CDM launched commercial mining in the foreshore area after construction of a seawall allowed mining to be extended to a distance of 190 meters to the seaward

side of the high water mark. The installation of a bucket wheel excavator increased overburden removal capacity to 1,000 cubic meters per hour. Overburden stripping increased from 42 million tons in 1975 to nearly 50 million tons in 1976. Further refinements in the dewatering system and stability improvements to the seawall were to allow operations to progress 200 meters seaward of the high water mark in the Western Block, a 9-mile strip just north of the mouth of the Orange River.

CDM's No. 2 conglomerate plant, commissioned in early 1975, was reportedly operating at full capacity during 1976. The No. 3 plant was commissioned toward yearend 1976 and was building up to the full production rate of 360,000 tons per month. Site leveling for the installation of an Electricity Supply Commission (ESCOM) power system for the mine began in May 1976; the project was scheduled for completion in May 1978.

CDM accelerated its pace of reconnaissance prospecting but initial results were not encouraging. At Arrisdrif, on the north bank of the Orange River, samples from nine pits sunk to bedrock were tested, but only one pit showed diamonds of commercial interest. Seismic equipment was employed in locating possible diamond traps on the foreshore, and sampling of extensive marine gravel deposits in the sea continued. In 1977, CDM planned to emphasize diamond sampling in the Western Block.

A second private firm, Kwazulu Mining Co., reported a diamond discovery in its 8,000-square-kilometer prospecting area east of CDM's Diamond Area No. 1. Fifty diamond pipes were located in the Huns Berge area, southwest of Keetmanshoop. Technical and feasibility studies were in progress at yearend.

MINERAL FUELS

Petroleum.—Southern Oil Exploration Corp. (South-West Africa) (Pty.) Ltd. (SWAKOR), the State agency responsible for granting oil exploration concessions, reported that petroleum prospecting was limited in 1976. SWAKOR is a subsidiary of Southern Oil Exploration Corp. (Pty.) Ltd. (SOEKOR), the South African organization entrusted with coordinating oil exploration in both the Republic and the Territory. The majority of foreign companies engaged in prospecting in the Territory relinquished their concessions during the period 1974–76. Among these were Getty Oil Co., Continental Oil Co., Phillips Petroleum Co., Chevron Oil Co., Texaco Inc., and Aquitaine (South-West Africa) Ltd. In addition, the assets of B. J. H. duPreez, who held four offshore concessions totaling 50,000 square kilometers, were taken over by Standard Bank of Southern Africa Ltd. during 1976.

Canada Southern Petroleum Ltd., as operator for a group that included Damson Oil Co., Aminex Ltd., and Asmera Ltd., all of Canada, and Aracca Petroleum Co. of the United States, continued seismic surveys in its 13,000-square-kilometer tract near the mouth of the Orange River. Another Canadian firm, Etosha Petroleum Co. (Pty.) Ltd., a subsidiary of Brilund Mines Ltd., held rights to a 300,000-square-kilometer onshore tract. No discoveries were reported during 1976.

The Mineral Industry of Spain

By Roman V. Sondermayer [1]

In 1976, Spain was an important producer of mercury, pyrite, fluorspar, strontium, gypsum, magnesite, lead, potash, feldspar, zinc, and petroleum refinery products. Production of other minerals and fuels was of only domestic significance.

The country's output of nonferrous ores, iron ores, and fuels did not meet local demand, and imports were essential for continued industrial activity. The mineral industry accounted for about 10% of the gross national product (GNP) or $10 billion[2] at current prices. However, the share of the extractive sector of the mineral industry was less than 1% of the GNP. The general economic situation was characterized by unemployment averaging 345,000 persons during the year, by an increase in the cost of living of 19.1%, and by a significant trade deficit of $7.3 billion. The mineral industry employed 212,000 persons. Labor unions were in a transitional stage from being government controlled to being similar to unions in other nontotalitarian countries in Europe. The Ministry of Industry implemented the minerals laws, regulated the private sector, and managed most Government-owned companies of the mineral industry through Instituto National de Industria (INI).

The Mining Development Law and the National Fuels Plan were approved by the Government during 1976. The Mining Development Law is expected to constitute the basis for future development of the mining sector. It contained several innovations. The most important were compulsory preparation of a 2-year national plan for the supply of minerals, a decision to set up a geological and mining data bank, regulation of activities abroad, financing of mining, and revision of the tax system for the mineral industry.

There were a number of significant developments during 1976. Construction continued on a 175,000-ton-per year aluminum plant and on an 800,000-ton-per-year alumina plant near San Ciprián (Province of Lugo), development continued at the Aznalcollar (Seville) mining complex, discovery of a new iron ore deposit near Granada was announced, development continued on lead and zinc deposits near Rubiales, and construction was completed on a 50,000-ton-per-year lead smelter. At the Almáden mercury mine, two new levels were prepared for production, and a new haulageway was excavated. Construction was underway on the site of an installation for total utilization of pyrites near Huelva, and a new plant for production of superfine and micronized red oxides was under construction near Malaga. Development of two lignite mines continued in the Province of La Coruña, and the first crude oil was discovered offshore Asturia in northern Spain.

PRODUCTION

Spain continued to develop new domestic mineral resources, and renovation of installations and introduction of modern equipment throughout the industry continued. The aim was to increase production of ores and concentrates and consequently cut imports of raw materials needed for the growing mineral processing and refining

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[2] Where necessary, values have been converted from Spanish peseta (Ptas) to U.S. dollars at the rate of Ptas70=US$1.00.

industry. Mine operations were characterized by low levels of mechanization and fragmented operations, resulting mostly from difficult geological and mining conditions. However, many metallurgical and petroleum processing plants were of modern design. As table 1 shows, trends in output were mixed. In spite of recession, outputs of some commodities during 1976 were higher than during 1975. The following tabulation shows major producers of minerals in Spain and their share in the country's total production:

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	ENDASA S.A.—plants at Áviles, Valladolid, Government 54%	61
Bituminous coal	Hunosa S.A.—mines at Caudal, Aller, and Nalón, Government 100%	54
Cement	Cía. General de Asfaltos y Portland Asland S.A.—7 plants	18
Copper ore	Rio Tinto Patinò S.A.—mines at Rio Tinto, Union Explosivos Rio Tinto (UERT)	90
Copper, refined	Rio Tinto Patinò S.A.—smelter and refinery at Huelva, UERT	60
Ferroalloys	Soc. Española de Carburos Metalicos S.A.—plants at Cee and Berga	50
Do	Hidro Nitro Española S.A.—plant at Monzón	30
Do	Ferroaleaciones Españolas S.A.—plant at Medina del Campo, Cargill Inc., United States	10
Iron ore	Cía. Andalusa de Minas S.A.—mine at Marquesado, Mokta 62%	34
Lead ore	Sociedad Minera y Metallurgica de Peñarroya de España S.A.—mines at Mantas de los Azules, Union, Peñarroya, France 98%	30
Lead, smelter	Sociedad Minera y Metallurgica de Peñarroya de España S.A.—smelter at Santa Lucía, Peñarroya, France 98%	70
Mercury	Ministry of Finance—mine and smelter at Almáden, Government 100%	100
Petroleum, refined	Empresa Nacional del Petróleo S.A.—refineries at Valle de Escombreras and Puertollano, Government 72%	42
Do	Cía. Esp. de Petróleos S.A.—refineries at St. Cruz de Tenerife, Algeciras, Banco Central	24
Potash	Potasas de Navara S.A.—mines near Pamplona, Government 100%	42
Do	Minas de Potasas de Suria S.A.—mines at Suria, Solvay, Belgium	18
Do	Unión Explosivos Rio Tinto S.A.—mines at Balsareny/Sallent and Cardona	21
Pyrite	Tharsis Sulfur and Copper Co.—mines at Tharsis and La Zarza, 51% Spanish private capital	46
Steel	Empresa Nacional Siderurgica S.A.—works at Áviles, Felguera, Gijón-Moreda, Gijón-Verina, Government 88%	46
Do	Altos Hornos de Vizcaya S.A.—works at Baracaldo-Sestao, U.S. Steel, about 20%	32
Zinc ore	Real Cía. Asturiana de Minas S.A.—mines at Reocín and Rubiales	50
Zinc, smelter	Real Cía. Asturiana de Minas S.A.—electrolytic zinc plant at San Juan de Nueva	85

Table 1.—Spain: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum:			
Bauxite	9,200	8,500	8,500
Metal:			
Primary	r 191,347	210,385	210,525
Secondary	43,848	34,500	40,000
Antimony:			
Mine output, metal content	134	80	152
Metal (regulus)	r 178	131	NA
Arsenic, white	166	12	e 10
Bismuth, mine output, metal content ---kilograms	(1)	--	--
Cadmium metal	178	206	246
Copper:			
Mine output, metal content	34,298	39,321	e 40,000
Metal:			
Blister	r 129,228	142,776	141,273
Refined, primary:			
Thermal	24,516	17,472	18,398
Electrolytic	121,188	121,164	131,868
Total	145,704	138,636	150,266
Refined, secondary	25,206	21,362	35,000
Gold, mine output, metal content ---troy ounces	r 223,351	124,584	e 270,000
Iron and steel:			
Iron ore and concentrate, gross weight ---thousand tons	8,238	7,641	7,608
Pig iron ---do---	r 6,904	6,843	6,624
Electric furnace ferroalloys ---do---	r 268	285	299
Steel:			
Crude ---do---	r 11,473	11,115	10,910
Castings and forgings ---do---	428	430	347
Total ---do---	11,901	11,545	11,257
Semimanufactures ---do---	r 12,324	11,281	12,017
Lead:			
Mine output, metal content	64,127	58,518	62,197
Metal:			
Primary	79,529	73,896	75,515
Secondary	6,054	6,415	3,020
Mercury:			
Mine output, metal content ---76-pound flasks	54,354	44,010	e 44,000
Metal ---do---	55,045	47,039	40,147
Silver:			
Mine output, metal content ---thousand troy ounces	4,099	3,447	e 3,200
Metal:			
Primary ---do---	2,894	3,054	3,107
Secondary ---do---	e 2,050	e 2,050	NA
Tin:			
Mine output, metal content	643	738	390
Metal:			
Primary	5,862	5,249	5,368
Secondary	160	121	NA
Titanium dioxide	20,023	17,143	21,110
Tungsten, mine output, metal content	r 347	351	349
Uranium, mine output, U_3O_8 content	r 79	225	205
Zinc:			
Mine output, metal content	r 94,757	85,297	81,410
Metal:			
Primary	130,006	138,045	158,471
Secondary	30	13	NA
NONMETALS			
Barite	103,962	77,095	e 77,000
Cement, hydraulic:			
Natural ---thousand tons	140	NA	NA
Other ---do---	23,660	23,970	25,202
Chalk ---cubic meters	151,200	2 232	NA
Clays:			
Bentonite	75,917	75,351	e 75,000
Kaolin, marketable:			
Crude	r 147,559	139,294	e 140,000
Washed	202,057	207,378	198,000
Refractory	447,627	480,542	NA
Other ---thousand cubic meters	6,847	2 11,428	NA
Diatomite and tripoli	27,297	20,370	e 20,000
Earths, industrial, n.e.s	20,499	25,105	NA
Feldspar and pegmatite	72,296	86,275	e 90,000

See footnotes at end of table.

Table 1.—Spain: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS—Continued			
Fertilizer materials:			
Crude potash salts, K_2O equivalent	495,282	567,040	509,715
Manufactured:			
Nitrogenous, nitrogen content—thousand tons	r 620	608	NA
Phosphatic, P_2O_5 content—do	r 456	515	NA
Potassic, K_2O equivalent—do	r 113	116	NA
Other including mixed—do	2,345	2,877	2,220
Fluorspar:			
Gross weight:			
Acid grade [3]	252,630	252,803	221,977
Metallurgical grade	107,944	82,061	e 73,000
Total	360,574	334,864	294,977
Calcium fluoride content:			
Acid grade [3]	245,652	245,587	215,766
Metallurgical grade	83,182	61,231	e 50,000
Total	328,834	306,818	265,766
Gypsum and anhydrite, crude—thousand tons	4,077	4,220	e 4,200
Kyanite and related materials, andalusite	7,311	5,042	e 6,000
Lime (quicklime and hydrated lime)—thousand tons	388	e r 400	e 400
Magnesite, crude	265,310	342,040	300,000
Meerschaum (sepiolite) crude	70,331	71,251	NA
Mica	--	527	e 600
Pigments, mineral, ocher	57,855	58,342	NA
Pumice	192,116	139,184	e 140,000
Pyrite, including cupreous:			
Gross weight—thousand tons	2,827	2,735	2,349
Sulfur content—do	1,308	1,264	e 1,100
Salt:			
Rock—do	1,625	1,833	e 1,900
Marine and other evaporated—do	632	1,299	e 1,300
Sand and gravel:			
Sand, silica—thousand cubic meters	[4] 1,081	[2 4] 1,607	NA
Other—do	13,626	[2] 21,448	NA
Sodium compounds:			
Sodium carbonate, manufactured	r 481,660	474,088	522,343
Sodium sulfate:			
Natural:			
Glauberite, Na_2SO_4 content	43,902	44,508	e 140,000
Thenardite, Na_2SO_4 content	85,370	93,063	
Manufactured	r 165,101	139,681	166,374
Stone:			
Calcareous:			
Dolomite—thousand cubic meters	1,332	[2] 1,964	
Limestone—do	36,200	[2] 79,026	
Marble—do	205	[2] 567	
Marl—do	2,854	[2] 6,485	
Basalt—do	653	[2] 3,404	
Granite—do	2,462	[2] 5,763	
Ofite—do	226	[2] 667	
Phonolite—do	221	[2] 599	NA
Porphyry—do	126	[2] 185	
Quartz—thousand tons	542	626	
Quartzite—thousand cubic meters	236	[2] 376	
Sandstone—do	735	[2] 1,143	
Serpentine—do	43	[2] 62	
Slate—do	527	[2] 1,065	
Trachyte—do	44	[2] 1	
Trass and tufa—do	256	[2] 226	
Strontium minerals	8,500	8,000	e 7,500
Sulfur, byproduct:			
Elemental from petroleum [e]	1,600	r 1,800	4,100
From lignite gasification [e]	1,400	1,400	1,400
From metallurgy	105,000	104,000	122,500
Talc and steatite	54,988	47,318	e 50,000
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	17,690	18,504	NA
Carbon black	54,755	40,862	50,336
Coal:			
Anthracite—thousand tons	2,948	3,154	3,489
Bituminous—do	7,391	7,470	6,994
Lignite—do	2,882	3,380	4,138
Total—do	13,221	14,004	14,621

See footnotes at end of table.

Table 1.—Spain: Production of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity		1974	1975	1976 p
MINERAL FUELS AND RELATED MATERIALS—Continued				
Coke:				
Metallurgical	thousand tons	4,333	4,861	4,423
Gashouse	do	NA	NA	1,769
Fuel briquets, all types	do	108	12	10
Gas:				
Natural, marketed	million cubic feet	35	39	41
Manufactured:				
Gas works	do	25,886	27,248	NA
Coke ovens	do	62,330	69,460	NA
Blast furnaces	do	99,780	e 100,000	NA
Total	do	187,996	196,708	NA
Peat		26,345	34,176	e 35,000
Petroleum:				
Crude	thousand 42-gallon barrels	14,334	14,822	11,552
Refinery products:				
Gasoline, motor	do	38,501	40,077	44,288
Jet fuel	do	15,265	17,157	17,489
Kerosine	do	1,518	1,940	1,284
Distillate fuel oil	do	71,735	62,720	77,221
Residual fuel oil	do	144,310	139,716	163,758
Lubricants, including grease	do	1,984	1,734	1,677
Other	do	41,074	36,497	48,388
Refinery fuel and losses	do	17,444	17,083	22,032
Total	do	331,831	316,924	376,137

e Estimate. p Preliminary. r Revised. NA Not available.
1 Revised to none.
2 Thousand metric tons.
3 Data presented include recorded production of salable acid grade fluorspar from both fluorspar mines and lead–zinc–fluorspar mines, plus some salable acid grade fluorspar obtained by beneficiating a portion of total reported salable metallurgical grade output.
4 Includes sand obtained from the washing of kaolin: 1974—250,246 cubic meters; 1975—578,635 tons.

TRADE

During 1976, the latest year for which complete data were available, Spain's balance of foreign trade was negative. Imports of ores, concentrates, and fuels, especially crude oil, contributed largely to the deficit. African and Middle Eastern countries were the largest suppliers of minerals. Value of mineral imports was reported at $6.0 billion, or 37% of total imports. Fuels, mostly crude oil, accounted for $4.1 billion, or 25% of total imports. Mineral exports, consisting mostly of various forms of metals and petroleum refinery products, totaled $1.1 billion, or 15% of total exports. European countries were the principal purchasers of Spanish mineral industries' products. Tables 2 and 3 show Spanish foreign trade in minerals.

Table 2.—Spain: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Oxide and hydroxide	60	59	United Kingdom 24; Portugal 14; Turkey 10; Bolivia 10.
Metal including alloys:			
Scrap	264	273	West Germany 158; Canada 54; Italy 40.
Unwrought	2,485	2,389	Portugal 1,538; Canada 722.
Semimanufactures	10,049	6,547	United States 1,346; Cuba 801.
Antimony metal including alloys, all forms	231	139	France 44; Netherlands 40; United States 35; Republic of South Africa 15.
Arsenic:			
Trioxide, pentoxide, acids	(1)	2	All to Argentina.
Metal including alloys, all forms	(1)	NA	
Beryllium metal including alloys, all forms kilograms	NA	NA	
Bismuth metal including alloys, all forms do	22	NA	
Cadmium metal including alloys, all forms	40	176	United States 93; Netherlands 50.
Chromium:			
Oxide and hydroxide	33	18	Colombia 7; Greece 5; Venezuela 3.
Metal including alloys, all forms	10	NA	
Copper:			
Ore and concentrate	3,909	3	All to United Kingdom.
Matte	1,275	NA	
Copper sulfate	(1)	2	All to Venezuela.
Metal including alloys:			
Scrap	176	141	NA.
Unwrought	7,163	17,230	France 11,124; United Kingdom 2,012; Netherlands 1,825.
Semimanufactures	5,881	8,207	Algeria 5,146; Israel 645.
Gold metal, worked and partly worked troy ounces	NA	NA	
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	2,962	1,960	West Germany 918; Netherlands 333; France 304.
Roasted pyrite do	516	531	Mainly to West Germany.
Metal:			
Scrap	2,333	1,529	Netherlands 906; France 240.
Sponge iron, powder, shot	5,857	6,162	France 1,862; Italy 1,782; Finland 770; West Germany 769.
Ferroalloys:			
Ferromanganese	35,943	17,215	West Germany 4,377; Sweden 3,931; France 3,414; Romania 2,502.
Other	r 47,229	25,432	West Germany 8,235; Romania 4,455; United Kingdom 4,152.
Steel, primary forms	66,258	15,603	United States 11,124; France 2,025.
Semimanufactures:			
Bars, rods, angles, shapes, sections	391,908	1,109,000	Iran 279,406; West Germany 132,215; Morocco 95,260; Turkey 86,764.
Universals, plates, sheets	100,490	279,237	United Kingdom 43,004; West Germany 40,344; Italy 27,398.
Hoop and strip	5,868	6,803	France 2,567; People's Republic of China 2,421.
Rails and accessories	164	14,624	Egypt 13,969; Poland 619.
Wire	7,140	7,642	Algeria 2,051; Portugal 1,318; Morocco 1,042.
Tubes, pipes, fittings	87,190	128,381	France 25,398; United States 15,880; West Germany 14,214.
Castings and forgings, rough	6,964	14,624	West Germany 2,929; Belgium-Luxembourg 1,692; Canada 1,637; Poland 1,459.
Lead:			
Oxides	8	1	All to Andorra.
Metal including alloys:			
Scrap	NA	NA	
Unwrought	342	1,564	Netherlands 1,001; United States 256.
Semimanufactures	274	74	Saudi Arabia 38; Nigeria 12.

See footnotes at end of table.

Table 2.—Spain: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Manganese:			
Ore and concentrate	144	24	All to France.
Oxides	341	1,769	France 1,640; Italy 100.
Metal	18	20	All to Austria.
Mercury ---76-pound flasks--	39,045	18,826	United States 4,264; United Kingdom 3,713; India 2,379; Romania 2,031.
Molybdenum metal including alloys, all forms ---kilograms--	909	3,000	United Kingdom 744; Bolivia 157.
Nickel metal including alloys:			
Scrap	333	462	France 215; West Germany 157.
Unwrought	180	14	Portugal 5; Iran 5; Venezuela 4.
Semimanufactures	35	42	West Germany 37; Sweden 4.
Platinum-group metals and silver:			
Waste and sweepings ---kilograms--	NA	NA	
Metals including alloys:			
Platinum group ---troy ounces--	3,247	3,569	Switzerland 1,479; West Germany 1,157; France 922.
Silver ---thousand troy ounces--	1	1,029	Switzerland 643; United Kingdom 354.
Selenium, elemental ---kilograms--	NA	300	All to West Germany.
Tantalum metal including alloys, all forms ---do---	NA	NA	
Tin:			
Ore and concentrates	NA	NA	
Metal including alloys:			
Scrap	43	33	United Kingdom 29; Netherlands 3.
Unwrought	1,643	1,573	Netherlands 980; Bulgaria 187; Romania 164.
Semimanufactures	3	10	Equatorial Guinea 6; West Germany 1; Portugal 1.
Titanium: Oxides	2,249	4,784	West Germany 924; France 720; Yugoslavia 540; U.S.S.R. 500.
Tungsten:			
Ore and concentrates	470	573	West Germany 280; United States 110; Netherlands 96; United Kingdom 59.
Metal including alloys, all forms	57	23	West Germany 15; Netherlands 2; Switzerland 2.
Vanadium:			
Oxides	NA	NA	
Metal including alloys, all forms ---kilograms--	NA	NA	
Zinc:			
Ore and concentrate	10,492	7,379	France 2,963; West Germany 2,349; Belgium-Luxembourg 1,104; Canada 963.
Oxide	162	333	West Germany 144; Belgium-Luxembourg 90.
Metal including alloys:			
Scrap	82	NA	
Blue powder	10,214	881	United States 575; France 200; Hungary 95.
Unwrought and semimanufactures	2,920	30,757	United States 24,601; Belgium-Luxembourg 4,199.
Other:			
Ores and concentrates of molybdenum, tantalum, titanium, vanadium, zirconium	405	184	Belgium-Luxembourg 50; France 45; Italy 40; United States 24; Morocco 20.
Ash and residue containing nonferrous metals	19,559	17,069	East Germany 11,003; Yugoslavia 3,500.
Oxides, hydroxides, peroxides of metals, n.e.s	426	398	Algeria 202; Portugal 100; Netherlands 60.
Metals including alloys, all forms:			
Alkali, alkaline earth, rare-earth metals	5	(1)	NA.
Pyrophoric alloys	2	(1)	NA.
Base metals including alloys, all forms, n.e.s	5	337	United States 128; Netherlands 91; France 55.

See footnotes at end of table.

Table 2.—Spain: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	2,091	784	West Germany 529; United Kingdom 126.
Dust and powder of precious and semiprecious stones (except diamond) value, thousands	(1)	$408	NA.
Grinding and polishing wheels and stones	r 1,793	1,824	West Germany 708.
Asbestos	16	162	Portugal 72; United Kingdom 48; France 18.
Barite and witherite	67,534	50,675	West Germany 44,489; Italy 4,850.
Boron materials, oxide and acid	159	262	Egypt 100; Republic of South Africa 81; Lebanon 30.
Cement thousand tons	1,746	3,682	Nigeria 1,189; United States 289; Israel 281.
Chalk	3,056	3,745	Portugal 1,980; Libya 1,650.
Clays and clay products: including all refractory brick:			
Crude clays, n.e.s.:			
Bentonite	18,857	24,200	Portugal 5,058; Netherlands 3,502; France 3,336.
Kaolin (china clay)	61,973	47,693	West Germany 14,613; Italy 9,728; France 7,928; Poland 6,985.
Other	15,411	10,556	Andorra 3,387; Portugal 3,362.
Products:			
Refractory including nonclay brick	7,939	13,439	Cuba 11,068.
Nonrefractory	178,647	269,436	Libya 39,207; France 38,109; West Germany 36,913; Iraq 31,655.
Diamond, natural and synthetic:			
Gem not set or strung value, thousands	NA	NA	
Industrial including powder do	$78	$620	Belgium-Luxembourg $310; Argentina $62.
Diatomite and other infusorial earth	5,656	1,239	Belgium-Luxembourg 419; France 276; United Kingdom 197; West Germany 135.
Feldspar, leucite, nepheline, nepheline syenite	1	1,406	France 1,125; Cuba 224.
Fertilizer materials:			
Crude and manufactured:			
Nitrogenous	86,374	14,121	Venezuela 6,492; Ireland 5,800; Portugal 1,274.
Phosphatic	(1)	NA	
Potassic	r 381,886	127,982	Algeria 36,596; Morocco 20,680; Norway 12,700; Japan 12,700.
Other	135,350	15,116	India 10,500; Portugal 2,309; Morocco 2,034.
Ammonia	12	17	Mainly to Mauritania.
Fluorspar	249,461	224,302	United States 141,209; West Germany 53,836.
Graphite, natural	1	88	Belgium-Luxembourg 86.
Gypsum and plasters	211,540	133,096	Sweden 40,433; Denmark 32,030; Finland 15,590.
Iodine	2	1	NA.
Lime	4,399	8,311	Equatorial Guinea 8,025.
Magnesite	72,305	87,360	United Kingdom 55,589; West Germany 16,759.
Mica, all forms	250	1,164	United Kingdom 1,000.
Pigments, mineral including processed iron oxides	15,503	9,991	United Kingdom 1,903; France 818.
Precious and semiprecious stones, except diamond:			
Natural value, thousands	$208	NA	
Manufactured do	$211	$1,054	Switzerland $744; United States $124.
Pyrite (gross weight) thousand tons	203	208	Belgium-Luxembourg 136; West Germany 30; United Kingdom 26.
Salt and brine do	2	37	Norway 15; Denmark 11.
Sodium and potassium compounds, n.e.s	36,606	41,168	Argentina 5,636; Brazil 5,629; Egypt 4,569; Morocco 4,516.
Stone, sand and gravel:			
Dimension stone:			
Crude or partly worked:			
Calcareous	15,967	11,664	Italy 6,057.
Slate	1,186	298	Equitorial Guinea 179; France 97.

See footnotes at end of table.

Table 2.—Spain: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Stone, sand and gravel—Continued			
Dimension stone—Continued			
Crude or partly worked—Continued			
Other	44,519	29,950	Italy 14,053; France 10,619; West Germany 3,556.
Worked:			
Slate	86,234	83,398	France 67,771.
Paving and flagstone	40	36	Portugal 17; Andorra 11; France 8.
Other	15,909	15,920	West Germany 11,812; France 2,361.
Dolomite	44,526	26,922	United Kingdom 24,495.
Gravel and crushed rock	35,232	37,922	Andorra 37,686.
Quartz and quartzite	167,471	270,118	Norway 223,310; Sweden 46,110.
Sand, excluding metal bearing	59,959	78,713	Andorra 75,813.
Sulfur:			
Elemental, all forms	772	175	France 135.
Sulfur dioxide	24	59	Portugal 30; Algeria 29.
Sulfuric acid	70,357	15,476	France 5,412; Italy 3,900; Algeria 2,951; Netherlands 1,761.
Talc, steatite, soapstone, pyrophyllite	183	1,938	Norway 1,000; United Kingdom 491; Italy 214.
Other, nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet	60,900	68,714	United Kingdom 19,459; France 18,972; West Germany 18,854.
Other	305,590	349,189	France 246,745; Belgium-Luxembourg 52,024.
Slag, dross, similar waste, not metal bearing	39,793	30,042	Portugal 28,905.
Oxides and hydroxides of magnesium, strontium, barium	852	1,241	U.S.S.R. 1,131.
Building materials, fiber cement, unfired nonmetals, n.e.s	34,475	62,725	France 15,209; Cuba 13,509; Nigeria 7,626.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	(1)	7	All to Equatorial Guinea.
Carbon black and gas carbons	NA	2,719	Portugal 2,498.
Coal and briquets:			
Anthracite and bituminous coal	70,874	18,922	Belgium-Luxembourg 14,814; Tunisia 2,202.
Briquets of anthracite and bituminous coal	980	NA	
Lignite and lignite briquets	122	96	All to Andorra.
Coke and semicoke	15,236	14,599	Mainly to Netherlands.
Hydrogen, helium, rare gases	9	88	Belgium-Luxembourg 84.
Peat including peat briquets and litter	112	100	All to Portugal.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	1,441	2,156	France 1,484; Italy 399; Belgium-Luxembourg 266.
Refinery products:			
Gasoline, including natural ----do----	8,009	4,106	Netherlands 1,088; Belgium-Luxembourg 935; West Germany 816.
Kerosine and jet fuel --------do----	1,678	798	Belgium-Luxembourg 310; Portugal 178; Netherlands 124.
Distillate fuel oil ----------do----	19,774	9,556	Netherlands 2,663; West Germany 1,746; U.S.S.R. 1,000.
Residual fuel oil ----------do----	4,490	2,451	NA.
Lubricants ----------do----	108	167	Cuba 47; Belgium-Luxembourg 27; United Kingdom 27; Syria 20.
Other:			
Liquefied petroleum gas --do----	215	962	Portugal 583; France 379.
Mineral jelly and wax ----do----	23	79	Venezuela 39; Portugal 16; Morocco 8; El Salvador 8.
Bitumen and other residues do----	925	1,127	Libya 715; Algeria 200.
Bituminous mixtures, n.e.s do----	294	261	Libya 170.
Pitch and pitch coke ----do----	r 65	55	France 50.
Unspecified ----------do----	11	406	Iraq 287; Portugal 77.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	7,332	17,879	Netherlands 14,133; France 1,349.

r Revised. NA Not available.
1 Less than ½ unit.

Table 3.—Spain: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	132,374	118,906	Guyana 42,345; Greece 42,059; Ghana 13,944.
Oxide and hydroxide	399,779	455,543	Republic of Guinea 165,890; Jamaica 123,180; France 96,831; Greece 62,042.
Metal including alloys:			
Scrap	4,439	4,320	Portugal 1,020; France 794; United States 687; Netherlands 589.
Unwrought	27,443	28,591	Norway 13,208; Netherlands 3,994; Hungary 3,009.
Semimanufactures	12,752	8,581	France 1,625; Belgium-Luxembourg 1,498; West Germany 1,176.
Antimony:			
Ore and concentrate	1,709	335	All from Morocco.
Metal including alloys, all forms	319	137	Czechoslovakia 76; Belgium-Luxembourg 32.
Arsenic:			
Trioxide, pentoxide, acids	421	455	France 420.
Metal including alloys, all forms	7	15	Sweden 11; Switzerland 2.
Beryllium metal including alloys, all forms kilograms	1	38	United States 36.
Bismuth metal including alloys, all forms	81	4	United States 1; United Kingdom 1; Yugoslavia 1.
Cadmium metal including alloys, all forms	NA	1	All from West Germany.
Chromium:			
Chromite	84,597	98,261	Turkey 42,701; Republic of South Africa 25,723.
Oxide and hydroxide	467	219	U.S.S.R. 99; West Germany 80; Poland 33.
Metal including alloys, all forms	55	13	United Kingdom 10; West Germany 1; France 1.
Cobalt oxide and hydroxide	194	109	Belgium-Luxembourg 45; United States 42; Canada 15.
Copper:			
Ore and concentrate	128,689	142,827	Australia 49,437; Ireland 31,309; Chile 18,292.
Matte	8,417	27,439	Chile 14,140; Israel 10,024.
Copper sulfate	2,187	2,365	France 949; U.S.S.R. 510; Belgium-Luxembourg 400.
Metal including alloys:			
Scrap	11,926	16,149	United States 8,636; France 2,232.
Unwrought	r 44,565	54,931	Chile 22,978; Republic of South Africa 8,363; Turkey 6,392; Zambia 6,288.
Semimanufactures	14,510	13,240	United Kingdom 2,765; West Germany 1,928; France 1,802; Italy 1,764.
Gold:			
Waste and sweepings kilograms	149	68	All from West Germany.
Metal, unworked or partly worked thousand troy ounces	198	1,157	United Kingdom 579; Switzerland 450.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	5,280	6,135	Venezuela 941; Australia 907; Canada 742.
Roasted pyrite	(1)	70,762	All from Brazil.
Metal:			
Scrap thousand tons	1,925	2,198	United States 1,456; United Kingdom 217; France 140.
Pig iron, including cast iron do	24	35	Canada 9; West Germany 5; Romania 4; Sweden 4.
Sponge iron, powder, shot do	10	7	Sweden 4; France 2.
Ferroalloys do	23	21	Republic of South Africa 5; France 4; New Caledonia 2.
Steel, primary forms do	416	1,202	West Germany 205; Belgium-Luxembourg 198; Greece 138.
Semimanufactures:			
Bars, rods, angles, shapes, sections do	157	219	Japan 61; West Germany 36; France 26; United Kingdom 26.

See footnotes at end of table.

Table 3.—Spain: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified).

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures—Continued			
Universals, plates, sheets thousand tons	248	317	France 77; West Germany 66; United Kingdom 47; Belgium-Luxembourg 34.
Hoop and strip ——do	44	41	France 16; West Germany 8.
Rails and accessories ——do	15	4	West Germany 2; United Kingdom 1.
Wire ——do	6	13	West Germany 4; Belgium-Luxembourg 3; France 2.
Tubes, pipes, fittings ——do	43	89	West Germany 22; France 20; Italy 13.
Castings and forgings, rough do	6	2	France 1.
Lead:			
Ore and concentrate	41,638	26,028	Morocco 18,275; Poland 5,811.
Oxides	704	243	Bulgaria 219.
Metal including alloys:			
Scrap	1,214	454	France 303; United Kingdom 122.
Unwrought	22,663	6,848	United Kingdom 3,242; France 1,691; Netherlands 1,371.
Semimanufactures	100	179	West Germany 152.
Magnesium metal including alloys, all forms	840	1,137	U.S.S.R. 830; United States 143.
Manganese:			
Ore and concentrate	384,103	437,379	Republic of South Africa 168,415; Congo 109,058; Ghana 54,328; Brazil 53,506.
Oxides	1,413	1,417	Japan 790; United States 515.
Metal	709	487	Republic of South Africa 312; Japan 135.
Mercury ——76-pound flasks	13	11	Austria 6; West Germany 5.
Molybdenum metal including alloys, all forms	34	22	United States 4; Austria 4; United Kingdom 3; Netherlands 3.
Nickel:			
Ore and concentrate	16,011	--	
Matte, speiss, similar materials	150	212	Finland 105; Canada 68; Norway 33.
Metal including alloys:			
Scrap	126	114	NA.
Unwrought	6,010	4,785	Canada 1,504; Cuba 1,459; United Kingdom 885.
Semimanufactures	2,571	3,061	Netherlands 963; France 907.
Platinum-group metals and silver:			
Ore and concentrate	6,438	6,668	Australia 5,799.
Waste and sweepings	411	499	United States 386; France 113.
Metal including alloys:			
Platinum group ——troy ounces	(1)	289,356	Brazil 225,055; France 51,152.
Silver ——thousand troy ounces	8,359	4,662	Belgium-Luxembourg 2,058; West Germany 965; United Kingdom 643.
Rare-earth metals:			
Oxides	192	112	France 86; United Kingdom 20.
Metals including alloys	18	7	Mainly from France.
Selenium, elemental	35	16	Japan 9; West Germany 2; Mexico 1; Yugoslavia 1; United States 1.
Silicon, elemental	311	9	Belgium-Luxembourg 7; France 1.
Tellurium, elemental	4	2	Mainly from Japan.
Tin:			
Ore and concentrate	6,156	7,467	Bolivia 4,044; Zaire 1,097; Indonesia 904.
Oxides	153	75	United Kingdom 37; West Germany 31.
Metal including alloys	109	93	Mainly from United Kingdom.
Titanium:			
Ore and concentrate	76,596	54,851	Norway 54,776.
Oxides	6,364	1,547	France 529; Belgium-Luxembourg 349; Finland 190; United Kingdom 176; West Germany 172.

See footnotes at end of table.

Table 3.—Spain: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Tungsten:			
Ore and concentrate	11,206	27	Japan 18; Thailand 9.
Metal including alloys, all forms	17	8	United Kingdom 2; France 1; Netherlands 1; United States 1.
Uranium and thorium:			
Ore and concentrate (uranium) kilograms	4	NA	
Oxides	14	1	All from United Kingdom.
Metal including alloys, all forms kilograms	461	493	Italy 472.
Vanadium:			
Pentoxide ---do---	389	15,000	United States 10,000; Netherlands 4,000.
Metal including alloys, all forms	5	2	All from United States.
Zinc:			
Ore and concentrate	126,404	137,901	Peru 44; Denmark 38; United States 15; Sweden 14.
Oxide and peroxide	2,119	346	West Germany 282.
Metal including alloys, all forms	2,197	117	NA.
Zirconium metal including alloys, all forms	1	5	France 2; West Germany 2.
Other:			
Ore and concentrate:			
Of molybdenum, tantalum, titanium, vanadium, zirconium	32,449	15,917	Australia 12,331.
Of base metals, n.e.s	588	NA	
Ash and residue containing nonferrous metals	95,266	20,415	United States 5,126; Canada 3,582; United Kingdom 2,802; West Germany 2,169.
Oxides, hydroxides, peroxides of metals	1,723	1,744	West Germany 583; France 460; Norway 218.
Metals including alloys, all forms:			
Alkali and alkaline earth	206	148	West Germany 128; Italy 19.
Pyrophoric alloys	15	8	France 6; United Kingdom 2.
Base metals including alloys, all forms, n.e.s	428	1,133	Republic of South Africa 312; Japan 155; United States 121; Belgium-Luxembourg 107.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	2,423	1,448	Greece 817; France 319.
Dust and powder of precious and semi-precious stones (except diamond) value, thousands	$47	$37	United States $22.
Grinding and polishing wheels and stones	1,732	1,480	United Kingdom 327; France 284; Italy 232.
Asbestos	125,971	94,114	Republic of South Africa 20,796; Canada 20,260; West Germany 13,915.
Barite and witherite	656	885	France 809.
Boron materials:			
Crude natural borates	81,110	68,723	United States 41,869; Turkey 26,830.
Oxide and acid	164	183	United States 100; France 51; West Germany 20.
Bromine	15	20	All from Israel.
Cement	162,486	100,228	United Kingdom 83,460; France 9,196.
Chalk	7,360	5,415	France 4,383; United Kingdom 626.
Clays and clay products including all refractory brick:			
Crude clays, n.e.s.:			
Bentonite	47,722	49,873	Morocco 17,939; Italy 16,476; Greece 7,695.
Kaolin (china clay)	139,804	121,370	United Kingdom 90,201; France 18,412.
Other	66,817	60,757	United Kingdom 35,537; France 11,873.
Products:			
Refractory, including nonclay brick	27,799	55,389	Italy 14,152; France 11,949; West Germany 11,338; Austria 10,160.
Nonrefractory	38,050	23,072	Italy 13,034; West Germany 3,887; Portugal 2,912.
Cryolite and chiolite	3,925	1,875	All from Denmark.

See footnotes at end of table.

Table 3.—Spain: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Diamond:			
Natural and synthetic:			
Gem not set or strung value, thousands	$9,636	NA	
Industrial including powder do	$4,326	$15,004	Republic of South Africa $3,844; Netherlands $2,604; United States $2,480; Belgium-Luxembourg $1,922.
Total do	$13,962	$15,004	
Manufactured, industrial do	$62	$310	Republic of South Africa $248.
Diatomite and other infusorial earth	2,863	2,815	United States 1,803; France 638; Algeria 300.
Feldspar, leucite, nepheline, nepheline syenite	16,448	16,633	France 10,772; Norway 3,215.
Fertilizer materials:			
Crude:			
Nitrogenous	39,902	31,662	All from Chile.
Phosphatic thousand tons	1,189	1,068	Morocco 989; United States 66.
Potassic	1	84,763	Canada 34,991; Israel 15,125; Congo 15,084; West Germany 8,104.
Manufactured:			
Nitrogenous	130,023	77,086	West Germany 22,850; Netherlands 16,534; Norway 15,140.
Phosphatic	32,117	18,031	France 8,718; Belgium-Luxembourg 8,332.
Potassic	49,613	84,764	Canada 34,992; Israel 15,125; Gabon 15,084.
Other including mixed	20,221	4,104	Belgium-Luxembourg 918; Italy 680; West Germany 523.
Fluorspar	17	9	West Germany 5; Netherlands 4.
Graphite, natural	1,650	1,546	Malagasy Republic 617; West Germany 302; Norway 168; Italy 155.
Gypsum and plasters	2,891	3,230	Morocco 1,914; France 959.
Iodine	61	32	Japan 30.
Lime	497	168	France 149; Morocco 17.
Magnesite	44,380	61,970	Greece 20,091; Italy 11,027; United Kingdom 10,239.
Mica, all forms	1,257	1,021	India 318; France 277; Austria 132.
Pigments, minerals including processed iron oxides	4,476	4,448	West Germany 3,622; France 500.
Precious and semiprecious stones, except diamond:			
Natural: Gem value, thousands	$8,171	NA	
Manufactured do	$629	$4,154	Belgium-Luxembourg $3,596.
Pyrite (gross weight)	140	112	Italy 63; United States 27; France 22.
Salt and brine	98,103	5,854	France 3,575; Netherlands 1,211; United Kingdom 606.
Sodium and potassium compounds, n.e.s	92,950	18,150	France 8,639; United States 4,122; West Germany 2,181.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	81,008	75,544	Italy 43,909; Portugal 29,243.
Slate	16	38	Andorra 23; West Germany 15.
Other	23,016	25,108	Norway 6,247; Republic of South Africa 4,672; Finland 4,432; Sweden 3,515.
Worked:			
Slate	668	119	Italy 118.
Paving and flagstone	58	14	Yugoslavia 8; Italy 6.
Other	3,175	3,646	Portugal 1,643; Italy 1,641.
Dolomite, chiefly refractory grade	3,297	2,702	France 1,724; Norway 906.
Gravel and crushed rock	36,743	26,540	Morocco 18,647; France 7,218.
Quartz and quartzite	1,875	3,272	Sweden 1,358; Yugoslavia 1,002; Belgium-Luxembourg 486.
Sand, excluding metal bearing	185,078	34,735	Morocco 17,083; Belgium-Luxembourg 7,652; France 5,120.
Sulfur:			
Elemental:			
Other than colloidal	114,580	66,675	France 52,327; Canada 12,058.
Colloidal	⁻161	120	Mainly from West Germany.
Sulfur dioxide	(1)	(1)	NA.

See footnotes at end of table.

Table 3.—Spain: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Sulfur—Continued			
Sulfuric acid	39,177	13,967	West Germany 9,993; Netherlands 3,908.
Talc, steatite, soapstone, pyrophyllite	10,163	8,708	France 6,092; Norway 993.
Other nonmetals, n.e.s.:			
Crude: Other	58,441	52,501	France 10,096; Greece 9,850; U.S.S.R. 9,102; Australia 6,890.
Slag, dross, similar waste, not metal bearing	2,341	6,735	Mainly from France.
Oxides and hydroxides of magnesium, strontium, barium	1,103	611	France 238; West Germany 107; United States 97; Japan 85; United Kingdom 72.
Building materials of asphalt, asbestos and fiber cement, and unfired nonmetals, n.e.s	2,322	2,320	France 1,237; United Kingdom 272; Belgium-Luxembourg 271; Canada 251.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,031	786	Mainly from United States.
Carbon black and gas carbon	14,265	15,699	France 8,780; Netherlands 3,074.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	3,245	3,974	Poland 1,492; West Germany 60; Australia 21.
Briquets of anthracite and bituminous coal	19	10	All from United Kingdom.
Lignite and lignite briquets	31,165	15,548	All from France.
Coke and semicoke	455,900	396,582	Italy 159,013; West Germany 101,407; United Kingdom 42,569.
Gas, natural liquefied—thousand cubic feet	54,702	59,152	All from Libya.
Hydrogen, helium, rare gases	1,139	8	United States 5; West Germany 1.
Peat, including peat briquets and litter	5,035	4,739	Mainly from West Germany.
Petroleum:			
Crude and partly worked thousand 42-gallon barrels	307,246	289,422	Saudi Arabia 135,569; Iraq 40,747; Iran 27,811.
Refinery products:			
Gasoline, including natural ---do---	457	510	Netherlands 204; Italy 128.
Kerosine ---do---	(1)	(1)	NA.
Distillate fuel oil ---do---	759	1,634	U.S.S.R. 843; Italy 328; Netherlands 187; France 164.
Residual fuel oil ---do---	7,029	3,796	Netherlands 1,166; Italy 380; Yugoslavia 366.
Lubricants ---do---	424	406	United Kingdom 67; Netherlands 53; Portugal 40; Greece 40.
Other:			
Liquefied petroleum gas ---do---	7,482	61,235	France 30,088; Algeria 8,052; Venezuela 5,121.
White spirit ---do---	4	43	Italy 17; France 9.
Mineral jelly and wax ---do---	247	79	France 16; Portugal 16; West Germany 16.
Bitumen and other residues do---	12	2	France 1.
Bituminous mixtures ---do---	6	6	United Kingdom 1.
Pitch, pitch coke, petroleum coke do---	1,823	1,628	United States 913; West Germany 484; United Kingdom 226.
Unspecified ---do---	165	889	West Germany 427; Netherlands 140.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals—thousand tons	167	119	United States 97.

r Revised. NA Not available.
1 Less than ½ unit.

COMMODITY REVIEW

METALS

A variety of metals was produced in Spain during 1976. The following tabulation shows the commodities, with the approximate number of mines for each:

Commodity	Number of mines
Copper	6
Iron ore	33
Iron-pyrites-copper	11
Lead	23
Lead-zinc	22
Lead-zinc-pyrites	4
Lead-zinc-fluorspar	8
Gold-silver	1
Pyrite-copper	--
Pyrite	10

Production of metals was adversely affected by increased costs for power, labor, and transportation. Value of metal mining accounted for about 23% of the total value of mining output in Spain.

Aluminum.—Construction continued on the alumina and aluminum complex of Aluminio Español S.A. (formerly Aluminio de Villagarcía S.A.) at San Ciprián (Province of Lugo). Annual production of the complex will be 800,000 tons of alumina and 175,000 tons of aluminum. The facilities will be built so that capacity can be doubled for alumina and increased to 270,000 tons for aluminum. Empresa Nacional del Aluminio (ENDASA) (controlled by INI) owned 55%; Aluminio de Galicia S.A. (ALUGASA), 20%; and others, 25% of the total capital of Aluminio Español. The plants will have a total payroll of 2,000. The San Ciprián facility is part of a large expansion program to increase aluminum-producing capacity in Spain from 216,000 tons in 1975 to 411,000 tons per year by 1980.

During 1976, four primary smelters were in operation. The aluminum industry suffered from the stagnation of the economy. The Government-owned company, ENDASA, was the major producer of aluminum and operated the country's largest smelter, a 110,000-ton-per-year plant near Aviles.

With its modest production of bauxite, Spain remained dependent on imports to meet the requirements of domestic refiners.

Copper.—Development of the Aznalcollar (Sevilla) mining complex operated by Andaluza de Piritas S.A. (APIRSA) continued. In addition to the mine, the complex includes a beneficiation plant, a water supply system, and auxiliary facilities. Yearly planned targets for the opencast operation were set at 2 million tons of pyrites and 1.5 million tons of copper pyroclast with an overburden-to-ore ratio of 3.2 to 1. The yield should be about 51,000 tons of copper concentrate, 42,000 tons of lead concentrate, and 98,000 tons of zinc concentrate. Proven reserves amounted to 78.5 million tons; approximately 44.5 million tons were complex sulfide ores (average metal content: 0.58% copper, 1.78% lead, 3.33% zinc, and 67 grams per ton of silver), and 34 million tons were cupriferous pyrite ores (average metal content: 0.58% copper, 0.40% lead, and 10 grams per ton of silver). The beneficiation plant will include crushing and milling facilities, differential flotation systems for sulfides, and dewatering installations. The complex is scheduled to start production in 1978.

During 1976, 29 mines produced copper, but Spain remained dependent on imports of concentrates and matte to meet demand. Six mines produced copper as main products, 10 pyrite mines produced copper as a byproduct, and 13 mines produced copper as a byproduct of iron output. Most of the copper mines were located in the Province of Huelva. There were four copper smelters and six copper refineries in operation during 1976. The largest smelter and refinery were located in the Province of Huelva and were operated by Rio Tinto Patino S.A.

Iron Ore.—Exploration continued on the iron ore deposit found during 1975 in the Marquesdado zone of the Province of Granada near the Alquife mines. Reports indicated reserves of about 30 million tons of high-grade ore. An annual production of 1 million tons was planned for the new mine. In addition, expansion of capacities was underway at the Andaluza de Minas (Province of Granada), Mineral del Andevalo (Provinces of Huelva and Badajoz), Agraminas (near Bilbao), and Sierra Minera mines (Provinces of Teruel and Guadalajara).

At Andaluza de Minas, output was planned to reach 4 million tons in 1980, about 1.3 million tons more than in 1975. Reserves were reported at 80 million tons

of hematite with an iron content of 47%. The mine was an open pit with 8-meter benches. Loading was with a 4.3-cubic-meter shovel, and transportation was in 32-ton dumpers. The mineral was crushed and upgraded to 56% iron by dense media. To facilitate shipments, a sea-loading facility capable of taking 80,000-ton ships and having a loading capacity of 2,500 tons per hour was under construction at Almeria. Investments for mine and port will total 2,000 million pesetas ($9 million).

At Minera del Andevalo, current production of 1.7 million tons should increase to 2.7 million tons by 1979. Mining was opencast with 12-meter benches. Loading was with 4- and 8-cubic-meter shovels, and ore and overburden were moved in 35- and 50-ton dumpers. After crushing, ore is magnetically concentrated to a product containing 60% iron. Investments will total 1,500 million pesetas ($22 million).

At Agrominas, present output of 8 million tons was planned to rise to 26 million tons of ore in 1979. Reserves were 81 million tons of 35% iron (mostly oxide and carbonate). The area was mined both underground (Bodovale) and opencast (Gallarta). At Bodovale, the mining method was room (25 meters) and pillar (20 meters). Loading and transportation were with 7-cubic-meter scooptrams. At Gallarta benches were 10 meters high. Loading was with 8-cubic-meter shovels, and transportation was with 75-ton dumpers.

At Sierra Minera, output of 1.8 million tons should reach 3.5 million tons by 1980. Reserves were of limonite (45% iron and 1.2% manganese). Mining was opencast with 10-meter benches. There was little use of explosives. Loading was with 5-cubic-meter shovels, and transportation was in 30- and 50-ton dumpers. From the drying plant, 2.5 million tons of fines were separated for sintering, and 1 million tons of ultrafines, which were mixed with imported high-grade ore, were converted into 2 million tons of 60% to 64% iron pellets. Investments were planned at 4,900 million pesetas ($72 million).

Iron and Steel.—During 1976, Empresa Nacional Siderúrgica S.A. (ENSIDESA) remained the principal steel producer in the country. With plants located at Áviles, La Felguera, Gijón-Moreda, and Gijón-Verina, this firm accounted for approximately 43% of the country's pig iron production and about 46% of steel output.

There were no installations for direct reduction of iron ore in operation during 1976, but two plants were planned. One installation, with two modules using natural gas as reductant, will be located in northern Spain near the port of Bilbao. Capacity will be 1 to 1.2 million tons per year. The other facility, with one module using manufactured gas as reductant, will be located in the Bay of Algeciras in southern Spain. Annual capacity will be 0.5 million tons. Both projects are planned to start operation at the end of 1980.

Lead and Zinc.—In 1976 development of the lead and zinc deposit near Rubiales in the province of Lugo, expansion of San Juan de Nieva zinc smelter, and completion of a new lead smelter at Linares continued. At Rubiales, the underground mine was scheduled for production in 1977. Annual output of approximately 115,000 tons of zinc concentrates and 15,000 tons of lead concentrates was planned. When in operation, mining will be by cut and fill in stopes 3.5 meters high and 250 meters long. Hydraulic filling, suspended timbering, and use of self-propelled jumbos and 5-ton shovels for loading were planned. Transportation will be by scooptrams and 10-ton trucks, and hoisting will be by means of skips driven by a 1,600-kilowatt Ward-Leonard unit. A 12% incline ramp will enable all the heavy materials to be lowered.

A differential flotation plant will have parallel circuits with 10 cells, four of which will be roughers. Proven reserves were reported at 7.5 million tons with an average zinc content of 9.9% and 3% lead. The development was financed by Cominco (45%), Union Corporation of South Africa (27%), and Asturiana de Zinc and Banco Urquijo (25%). In addition, lead and zinc concentrates will be produced at the new mining operation, Aznalcollar, Seville, described in the copper section of this chapter. Expansion continued on the zinc smelter at San Juan de Nieva, owned by Peñarroya. When completed in 1977, smelter capacity will have been increased from 130,000 tons to 205,000 tons of zinc per year.

A 50,000-ton-per-year lead smelter was completed near Linares in mid-1976, replacing an obsolete plant. By yearend, lead output totaled 21,000 tons. Five companies were participating in the venture (Peñar-

roya, El Adaro, Los Guindos, La Cruz, and CARM).

During 1976, there were 23 lead mines, 22 lead and zinc mines, 4 zinc-lead-pyrite mines, and 7 zinc-fluorspar mines operating in Spain. Approximately 50% of the zinc produced in Spain was mined in the north near Santander, and about 30% was mined in the district of Cartagena in southern Spain. Two zinc smelters and four lead smelters were operating at yearend 1976. Peñarroya was the largest producer of lead and operated the largest lead smelter in the country, located near Santa Lucía, Cartagena. Asturiana de Zinc S.A. was the major zinc producer and operated the largest Spanish zinc plant, the San Juan de Nieva. At yearend, installed capacity in Spain for production of zinc was 110,000 tons per year, and there was 106,000 tons of lead production capacity. Spain was dependent on imports of lead and zinc raw materials to supplement domestic supply. However, this position should improve after all lead-zinc mines become operational.

Mercury.—With the Almáden mercury mine and smelter, Spain remained the largest mercury producer in the world during 1976. Major activities were in developing a new transportation system for ore and materials and preparing two levels (about 12 years of production at present rates) for production. During 1976, ore was brought to the surface through a shaft far from the smelter. A new main haulageway was excavated at the 570-meter level, and a shaft near the smelter will be used for hoisting ore. Production was cut because of low demand, but stocks of mercury increased. However, development of new levels for production continued, financed by the Government, which owned Almáden.

In addition, exploration was underway on a mercury deposit situated approximately 15 kilometers southeast of Almáden. Two new mercury-bearing veins were discovered; preliminary tests indicated that both extended under a river and a road, but opencast mining was considered. The new ore was suitable for smelting in the available smelter. However, a final decision to start a new mine was not arrived at during the year.

At the smelter, which operated far below its capacity of about 70,000 flasks per year, corrosion of condensers remained a major problem. At Almáden, two methods were adopted to combat corrosion. One was to replace cast iron condensers, which have a 1-year life, with condensers made of corrosion-resistant steel, which last 5 years. The other was to replace the condensers with a new unit developed in Almáden. Testing of the new installation, which required large quantities of water, was hampered by extreme drought in the area of Almáden during 1976.

Pyrites.—Production of pyrite was from mines operated by Union Explosivos Rio Tinto and Compania de Azufre y Cobre de Tharis.

Construction of a plant for recovering base metals and pelletizing iron cinders from pyrite for use in the steel industry was underway. When construction of the plant is completed in 1979 or 1980, the Aprovechamiento Integral de Piritas S.A. will process about 1 million tons of pyrite and recover 0.9 million tons of 63% iron pellets, 10,000 tons of copper concentrate, 8,000 tons of 65% lead concentrate, 32,000 tons of 66% zinc concentrate, and lesser quantities of cadmium, silver, and gold.

Exploration activity continued at Sotiel in the Province of Huelva. The decision as to how the orebody would be mined had not been reached, but the management was trying to determine the viability of opencast production from a deposit located far from existing railroads, where the overburden to ore ratio was 10:1 and where the method of benefication was not established. The opencast project called for an annual output of 2 million tons. Reserves, confirmed by drilling, were reported at 42 million tons. In addition to sulfur and iron, average metal content of Sotiel ore was 0.8% copper, 3.1% zinc, and 0.4% lead. A flotation pilot plant was completed at yearend. Contractor and designer for the plant was Metallgesellschaft A.G. of West Germany.

Other Metals.—No major events were reported in production of tin (18 mines), tungsten (5 mines), tin-tungsten (4 mines), antimony (2 mines), and gold and silver (1 mine) during 1976. Output of these mines was of only domestic significance.

NONMETALS

Spain produced a large variety of nonmetals. Their importance was mostly limited to the domestic economy, but potash, ocher, natural sodium sulfate and

celestite were significant by European standards.

Barite.—About 26 barite producers operated mines and plants in Spain during 1976. The principal zone of production was the Espiel area of Cordoba. The major producer in the Espiel area was Minas de Baritina S.A., a subsidiary of Kali-Chemie A.G. of West Germany, which operated a 50,000-ton-per-year barite plant producing high-quality oil-well-drilling grades.

Celestite.—Spain remained one of the few world sources of the strontium mineral celestite. Together with the United Kingdom, Spain provided the only commercial output in Europe. The output came from an operation situated at Montevive, Granada.

Cement.—Spain was among the world's principal exporters of cement during 1976. Production capacity of the Spanish cement industry was 34 million tons at yearend. The following companies were among the largest producers during 1976: Cía. General de Asfaltos y Portland Asland S.A., Barcelona (4.2 million tons of kiln capacity, seven plants); Portland Vardirrivas S.A., Madrid (2 million tons, two plants); Cementos Uniland S.A., Barcelona (1.9 million tons, two plants); and Compania Valenciana de Cementos Portland S.A. (1.9 million tons, three plants).

Mineral Pigments. — *Ocher.* — During 1976, a new 12,000-ton-per-year plant for production of superfine and micronized grades of red oxide was under construction in Malaga. The investor was Oxidos Rojos de Malaga S.A., a subsidiary of Golden Valley Colours Ltd. of the United Kingdom.

In Spain, seven mines produced ocher. Most of the mines were situated in the Provinces of Jaen and Granada. The crude ore was processed in Malaga by Oxidos Rojos de Malaga S.A. and in Almeira by Oxidos del Sur S.A.

In addition, Spain produced red, yellow, and black oxides in the Saragoza area. Most of the production of oxides was exported.

Potash.—Four potash mines were in production during 1976. Three were located in the Province of Barcelona, but one mine in Navarra accounted for about 34% of the output. At Minas de Potasa de Suria, work continued to increase annual output by 50,000 of K_2O and reach production of 200,000 tons per year in 1980. The program included development of a new mine in the Suria area.

Potasas de Navara started development of new zones within the potash deposit near Pamplona. To be able to handle additional ore, capacity for carnallite beneficiation in the area will be increased to 150,000 tons of K_2O by 1978–79.

Salt.—Rock salt, salt from brine, and marine salt were sources of supply in Spain during 1976. Domestic output was adequate to meet demand. Some exports were made, mostly marine salt from a new, large operation (annual capacity 500,000 to 1 million tons), situated at Torrevieja (Alicante) and owned by Union Salinera de España S.A.

The largest rock salt producer remained Solvay Cie. S.A. (part of Belgian Solvay Group, with the Polanco mine near Santander), with an annual capacity over 1 million tons. Potasas de Navarra produced salt as a byproduct of potash mining in Navarra. Another rock salt producer was Industrial Salinera Aragonesa.

Brine salt was produced at 59 operations. However, three producers, located in Alicante, accounted for 27% of total brine salt output.

Sodium Sulfate.—Although thenardite and glauberite occurred at a number of locations, only two mines were in operation in Spain: El Castilar thenardite mine at Villarubia de Santiago in Toledo Province, operated by Union Salinera de España S.A.; and the glauberite mine at Cerezo del Rio Tiron in the Province of Burgos, operated by Criaderos Minerales y Derivados S.A.

Other Nonmetals.—Recent trends in output of other nonmetallics are shown in table 1. For selected commodities the approximate number of producing facilities are listed in the following tabulation:

Commodity	Number of facilities	Provinces with largest output and number of facilities
Andalusite	8	Coruña (7), Pontevedra (1)
Bentonite	26	Almeria (21), Madrid (3), Toledo (2)
Kaolin	125	Valencia (33), Teruel (25)
Feldspar	14	Lugo (3), Madrid (2)
Fluorspar	20	Oviedo (10)
Magnesite	3	Madrid (1), Lugo (1), Navarra (1)
Quartz	20	Coruña (4), Guadalajara (3), Vizcaya (3)
Sand and gravel	536	Barcelona (76), Madrid (35), Burgos (38), Oviedo (29), Baleares (22)
Gypsum	343	Barcelona (19), Murcia (19), Zaragoza (23), Alicante (18)

MINERAL FUELS

Petroleum, mostly imported, remained the principal source of energy in Spain. During 1976, about 83% of Spain's apparent fuels consumption was met through imports. Crude oil and petroleum refinery products accounted for about 94% of fuels imports. Coal was the principal fuel produced in the country and provided 13% of apparent fuel consumption. However, additional imports of high-rank coals were necessary to meet demand. Table 4 shows supply and apparent consumption of fuels and power for 1975 and 1976 in million tons of standard coal equivalent (SCE).

Approximately 60,000 persons were employed in the fuel industry of Spain.

Coal.—Activities in the coal industry included expansion and renovation of coal mines, stimulated by the tax relief and credit policies of the Government. During 1976, a number of firms within the coal mining sector entered into Concerted Action Agreements with the Spanish Government for the purpose of increasing coal production. These agreements call for an output of 33.7 million tons of coal by 1980.

Development of the Meirama and Puentes de Garcia Rodriguez lignite deposits, both in the Province of La Coruña, were among the major projects related to Concerted Action Agreements. The Meirama deposit, with 70 million tons of proven reserves of lignite (calorific value 2,000 kilocalories per

Table 4.—Spain: Supply and apparent consumption of fuels and power in 1975 and 1976

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood	Hydroelectric power and nuclear power
1975:						
Production	19.9	12.7	2.6	(2)	(2)	4.6
Imports	66.8	4.3	62.5	(2)	(2)	(2)
Exports	4.0	(2)	4.0	(2)	(2)	(2)
Apparent consumption	82.7	17.0	61.1	(2)	(2)	4.6
1976:						
Production	20.2	12.4	3.5	(2)	(2)	4.3
Imports	77.8	4.8	73.0	(2)	(2)	(2)
Exports	4.5	.1	4.4	(2)	(2)	(2)
Apparent consumption	93.5	17.1	72.1	(2)	(2)	4.3

[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Less than 0.01 million tons of standard coal equivalent.

kilogram), was planned for an opencast mine. The mining will be in two phases. During the first phase, benches will be 10 meters high, and 1,320-cubic-meter-per-hour shovels will be used. During the second phase, benches will be 30 meters high, and 6-cubic-meter draglines will be used. When in operation, mine output should reach 24 million tons per year.

A 122-million-ton-per-year opencast lignite mine was under development at Puentes de Garcia Rodriguez. Reserves were reported at 350 million tons of lignite (1,800 kilocalories per kilogram). The mine will have benches 35 meters high and will use 1,400- and 1,800-cubic-meter bucket wheels.

During 1976, Spain produced anthracite (69 mines), bituminous coal (39 mines), and lignite (34 mines). The Provinces of Oviedo and Leon were the largest producers of anthracite and bituminous coal. Most of the lignite was produced in the Provinces of Tereul, Barcelona, and Coruna. Imports of coal, mostly coking coals, were an important part of the supply.

At yearend 1976, a formed-coke plant went onstream near the port of Musel, north Spain. Annual processing capacity was 7.6 million tons of coal, and there was 800,000 tons of storage space. The total investment exceeded $36.8 million.

Petroleum and Natural Gas.—During 1976, domestic output of crude oil and natural gas was modest, and Spain remained almost totally dependent on imported crude oil and natural gas. Exploration, both offshore and onshore, continued in an effort to lessen this dependence.

Onshore exploration, including field geology and seismic, was conducted in the Provinces of Logrono, Gerona, and Galicia and near Barcelona. Most of the onshore wells were dry. Onshore production declined, leaving offshore areas as the most promising regions for future oil and gas production.

Exploration, both seismic and drilling, was concentrated in the Mediterranean and in the Bay of Biscay off the northern coast of Spain. Results of exploration were mixed. The drilling in the Gulf of Cadiz and off Andalusia was negative, the importance of the Mediterranean between Barcelona and Valencia was confirmed, and a discovery was made in the waters of Asturia in northern Spain.

The most significant event of the year was the confirmation of Chevron's discovery of oil in the Casablanca Field, situated west of the Amposta Field. Based on a flow test of 9,500 barrels per day, reserves were reestimated at 225 million barrels. Reserves of that magnitude make the Casablanca discovery the most important one in the northern Mediterranean. In addition, Shell's Castellon B–5 well produced 7,100 barrels per day during one test. This well confirmed results of drilling with well Castellon B–2 and establishment of a modest oilfield, Tarraco. Shell announced discovery of oil in Mare Cantabrico, offshore Asturias. Tests showed an output of 7,000 barrels of crude oil per day, but further drilling is needed for evaluation of the discovery.

A large new oil port was under construction near Bilbao; partial operation had started during 1975. The new port will have facilities for berthing ships of up to 500,000 deadweight tons. Completion of construction was expected during 1977.

Two new oilfields, one near Burgos and one near Tarragona (total yearly output, about 2 million tons), and 10 refineries (installed capacity, 59.6 million tons) were in operation in Spain during 1976; the refineries operated at 70% of installed capacity. The following tabulation shows operational petroleum refineries in Spain:

Company	Location	Annual capacity (million tons)
Empresa Nacional del Petróleo, S.A. (ENPETROL)	Escombreras	10
Do	Puertollano	6
Do	Tarragona	7
Compania Iberica Refinadora de Petróleos, S.A. (PETROLIBER)	La Coruña	5
Compania Española de Petróleos, S.A. (CEPSA)	Santa Cruz de Tenerife	8
Do	Algeciras	6.5
Petróleos del Mediterraneo, S.A. (PETROMED)	Castellon de la Plana	4
Union Explosivos Rio Tinto, S.A. (ERT)	Huelva	4
Refineria de Petróleos del Norte, S.A. (PETRONOR)	Somorrostro	8
Asfaltos Españoles S.A. (ASESA)	Tarragona	1.1
Total		59.6

Retail prices for petroleum refinery products during 1975 and 1976 are shown below in cents per gallon (except for bunker "C" fuel oil, which is given in cents per 42-gallon barrels):[3]

	July 1976	July 1975
Motor gasoline:		
Regular	121	113.6
Premium	150	129.8
Household kerosine	69	64.9
Motor lubricating oil	472	454.1
Distillate fuel oil	40	34.5
Bunker "C" fuel oil	1,143.6	1,108.6

The modest domestic output of natural gas was far below the country's demand. Imports of liquefied natural gas were supplied largely by SONATRACH of Algeria. Construction was underway during the year to expand the Barcelona regasification plant to 240 million cubic feet per day.

The preliminary study for building a gas pipeline between Algeria and Spain was completed in 1976. Sociedad de Estudios del Gasoducto Mediterraneo Occidental, formed in 1972 by SONATRACH of Algeria (50%), Gas de France (25%), and ENAGAS (25%), coordinated and financed the study.

Uranium.—Spain became a regular producer of uranium concentrate, (yellow cake U_3O_8) during 1976. After a trial production, which started in May 1975, a 112-ton-per-year U_3O_8 concentrator, situated in Ciudad Rodrigo, was fully operational in 1976. Uranium mines in the area supplied ore to the plant. The installation was operated by Empresa Nacional del Uranio S.A. (ENUSA), a company owned 60% by the Government of Spain through INI and the rest by seven Spanish utility companies. Development of another uranium deposit continued in Ciudad Rodrigo, and expansion of the existing concentrator was underway. The objective was to create a uranium mining and beneficiation complex with a capacity of 600 tons of U_3O_8 by 1979. Construction of nuclear power plants continued in Spain. Three nuclear powerplants (1,120 megawatts electrical), were in operation and five (6,555 megawatts electrical) were under construction.

[3] U.S. Bureau of Mines. International Petroleum Annual, 1975. March 1977, p. 36.

The Mineral Industry of Sweden

By Joseph B. Huvos [1]

In 1976, the mineral industry of Sweden remained small but technologically advanced. Sweden was one of the world's largest iron ore producers and exporters and there was a significant production of nonferrous metals and hydroelectric power. Fossil fuels and many important industrial minerals were imported. The most important mineral products of the country and approximate percentages of world totals were as follows: White arsenic, 20%; selenium, 4%; iron ore, 3%; lead (mine), 2%; lead (smelter), 1%; zinc (mine), 2%; pyrite, 2%; feldspar, 2%; copper (mine), 0.6%; copper (refined), 0.7%; and tungsten, 0.5%.

In 1976, Sweden's gross national product (GNP) was about $74 billion.[2 3] Mining and quarrying including stone and clays contributed approximately 2%; iron and steel and metals, about 2%; and the chemical industry, 3%. The national labor force was about 4.1 million.

The recovery of the economy was delayed by slower than expected economic recovery abroad; the Government attempted to dampen the growth of consumer demand by higher taxes and maintained a full employment policy.

Indices of mineral industry production in 1975–76 are shown in the following tabulation:

Industry sector	1968=100	
	1975	1976
Iron ore mining	117	111
Nonmetallic mineral products	95	89
Base metal industries	121	117
Mining, quarrying, manufacturing	130	129

There were many significant developments in Sweden's mineral industry in 1976. The Government made studies for reorganizing the country's steel industry. The "Steelwork 80" project was shelved. Boliden AB reorganized its corporate structure; the company's Stekkenjåkk mine was commissioned; Société des Mines et Fonderies de Zinc de la Vieille Montagne S.A. completed the expansion of its Åmmeberg mine; and construction at Luossavaara-Kiirunavaara AB's (LKAB) maritime iron ore loading facilities continued. Finally, Boliden closed two mines and Surhammars Bruks AB closed three mines.

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted to U.S. dollars from Swedish kroner (SKr) at the rate of SKr4.3559=US$1.00 for 1976.

[3] U.S. Department of Commerce. Foreign Economic Trends and Their Implications for the United States. Sweden. March 1977, p. 3.

PRODUCTION

In 1976, production of many mineral industry products continued to decrease because of a slow recovery in export markets. Production of mineral commodities is shown in table 1. The following tabulation shows major producers of commodities:

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	Gränges Aluminium AB, smelter at Sundsvall, Gränges AB 79%, Alcan Aluminum Ltd. 21%	100
Cement	Cementa AB, plants at Slite, Limhamn, Skövde, Hällekis, Stora Vika, and Degerhamn, Industri AB Euroc 95%; LKAB 5%	100
Copper	Boliden AB, mine at Aitik, smelter at Rönnskär, Royale Asturienne des Mines, Belgium	85
Do	Stora Kopparbergs Bergslags AB (SKB), mine at Falun	15
Ferroalloys	Airco Alloys AB, plant at Vargon, AB Airco Inc., United States	50
Do	AB Ferrolegeringar, plant at Trollhättan, Metallurg Inc., United States	30
Iron ore	LKAB, mines at Kiirunavaara, Tuolluvaara, Leveäniemi, and Nukutusvaara, Government	83
Do	Gränges AB, mines at Grängesberg and Stråssa, Vestra Ormbergs Grufve AB	5
Do	SKB, mines at Dännemora, Rikberg, Håksberg, Blötberg, and Vintjärn	5
Iron and steel	SKB, plant at Domnarvet	40
Do	Gränges Stål AB, plant at Oxelösund, Vestra Ormbergs Grufve AB	33
Do	Norbottens Järnverk A/S (NJA), plant at Luleå, Government	27
Lead and zinc	Boliden AB, mine at Laisvall, lead smelter at Rönnskär	70
Do	Vieille-Montagne, mine at Åmmeberg, Vieille Montagne, Belgium	30
Petroleum products	Skandinavska Raffinaderi AB (Scanraff), refinery at Lysekil, Government, Texaco Oil AB	40
Do	BP Raffinaderi AB, refinery at Göteborg, BP	27
Do	Koppartrans Olje AB, refinery at Göteborg, Svenska Shell	24
Pyrite	Boliden AB, mines at Falun, Långsele, Kristineberg, Rävliden, and Rutjebäcken	90
Tungsten	LKAB, mine at Yxsjöberg	100

Table 1.—Sweden: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 p
METALS			
Aluminum, unalloyed:			
Primary	82,008	76,787	82,517
Secondary	472	606	--
Arsenic:			
White, refined	13,300	10,500	5,800
Metallic	1,050	900	1,100
Bismuth, mine output, metal content e	15	15	15
Copper:			
Mine output, metal content	40,637	40,634	44,860
Metal, unrefined	--	807	2,561
Metal, refined:			
Primary	47,478	49,468	55,566
Secondary	12,430	6,753	7,301
Total	59,908	56,221	62,867
Gold:			
Mine output, metal content, troy ounces	68,352	63,176	62,179
Metal including alloys, do	118,990	109,923	147,700
Iron and steel:			
Iron ore and concentrate, gross weight:			
Direct shipping ore, thousand tons	23,643	18,847	17,126
Concentrate, do	12,509	12,020	12,735
Total, do	36,152	30,867	29,861
Metal:			
Pig iron and sponge iron [2], do	3,176	3,484	3,139
Electric furnace ferroalloys:			
Silicomanganese	9,751	8,558	7,461
Ferrosilicon	50,437	50,219	36,726
Ferrochromium	100,765	92,358	116,486
Ferrochromium-silicon	18,417	15,513	5,877
Ferrotungsten	585	722	422
Ferromolybdenum	2,035	1,659	1,830
Ferrovanadium	456	407	575
Crude steel, thousand tons	5,989	5,611	5,140

See footnotes at end of table.

Table 1.—Sweden: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures:			
Bars, rods and sections ---thousand tons--	1,621	1,494	1,364
Plates and sheets ---do---	2,125	1,927	1,753
Strip ---do---	164	115	120
Rails and accessories ---do---	50	57	66
Pipe and tube stock ---do---	266	253	227
Other, including forgings and castings ---do---	247	280	292
Total ---do---	4,473	4,126	3,822
Lead:			
Mine output, metal content	73,656	70,383	81,625
Metal (refined):			
Primary	45,185	38,342	49,485
Secondary and remelted	22,891	18,016	e 18,000
Magnesium metal, secondary	13	--	--
Nickel metal, unalloyed	4,265	3,045	e 3,000
Selenium, elemental (refined)	48	67	e 70
Silicon metal	17,569	16,463	e 16,000
Silver:			
Mine output, metal content ---thousand troy ounces--	4,545	4,515	4,617
Metal including alloys ---do---	6,006	7,034	6,363
Tungsten, mine output, metal content	215	143	194
Uranium oxide (U_3O_8) [e]	70	70	70
Zinc:			
Mine output, metal content	113,699	111,325	128,326
Clinker (70% to 75% zinc)	26,900	25,200	26,100
NONMETALS			
Cement, hydraulic ---thousand tons--	r 3,736	3,406	2,796
Chalk	44,135	33,945	37,529
Clays, refractory ---thousand tons--	r 207	187	176
Diatomite, calcined	566	423	327
Feldspar, salable, crude and ground	31,964	44,742	44,746
Fertilizer materials, manufactured:			
Nitrogenous ---thousand tons--	643	634	NA
Phosphatic:			
Thomas slag, gross weight ---do---	148	137	147
Other ---do---	626	372	NA
Mixed and other ---do---	879	905	NA
Fluorspar	4,074	3,405	3,324
Gypsum, manufactured	NA	89,900	142,800
Lime (quicklime, hydrated lime, and deadburned dolomite) thousand tons--	r 1,000	927	858
Pigments, natural, mineral	1,083	1,440	1,009
Pyrite and pyrrhotite (including cupreous), gross weight thousand tons--	425	414	404
Stone, sand and gravel:			
Dimension stone:			
Unworked:			
Limestone and marble ---do---	38	36	34
Granite and gneiss ---do---	72	64	62
Quartz ---do---	47	41	29
Quartzite ---do---	22	22	23
Micaceous schist ---do---	19	18	19
Sandstone ---do---	44	38	31
Other ---do---	36	32	26
Worked, all types [3] ---do---	98	92	86
Crushed, broken and other:			
Clay slate ---do---	81	68	74
Dolomite:			
Crude ---do---	r 464	405	370
Burnt ---do---	37	32	40
Granite and gneiss ---do---	6,994	7,696	7,826
Limestone:			
For cement ---do---	r 5,045	4,336	3,479
For lime ---do---	1,221	1,050	881
For other industrial uses (including lime marl) ---do---	1,771	2,054	2,000
Marble ---do---	r 1	--	--
Micaceous schist ---do---	16	17	--
Quartz ---do---	22	18	17
Quartzite ---do---	1,902	1,933	1,795
Sandstone ---do---	353	290	260
Other ---do---	534	1,064	906

See footnotes at end of table.

Table 1.—Sweden: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
NONMETALS—Continued			
Sulfur:			
Content of pyrite ---thousand tons--	218	211	205
Byproduct:			
From metallurgy ---do---	132	[r] [e] 125	[e] 130
From other sources ---do---	9	13	[e] 13
Total ---do---	359	349	[e] 348
Talc and steatite	28,404	23,846	20,442
Other, crude [4]	13,394	NA	5,873
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	27,650	24,576	[e] 25,000
Coal, all grades ---thousand tons--	11	10	12
Coke, metallurgical ---do---	481	829	1,072
Oil shale:			
For fuel production use ---do---	101	88	30
For other use ---do---	11	10	11
Peat:			
For agricultural use ---do---	73	77	89
For fuel use ---do---	36	34	32
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels--	9,592	12,989	20,893
Jet fuel ---do---	950	1,013	656
Kerosine ---do---	101	--	39
Distillate fuel oil ---do---	[r] 24,833	26,700	34,555
Residual fuel oil ---do---	29,148	33,664	38,908
Lubricants ---do---	644	294	210
Other:			
Naphtha ---do---	1,988	491	383
White spirit ---do---	1,340	101	1,717
Unspecified ---do---	566	3,868	5,320
Refinery fuel and losses ---do---	5,501	2,850	6,795
Total ---do---	74,663	81,970	109,476

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, cobalt, nickel (as nickel sulfate) and metallic titanium are also produced but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2] Production of sponge iron is as follows in thousand tons: 1974—197; 1975—175; 1976—187.

[3] Represents material for sale, not produced.

[4] Includes strontium minerals, unspecified minerals, and fragments of ceramic materials.

TRADE

Export market conditions caused Sweden's trade deficit to almost double in 1976. Otherwise there was no major change in the country's mineral trade pattern. Sweden continued to trade with about 170 countries, although the bulk of the trade was with the other Scandinavian countries and West Europe. The main mineral commodities exported in 1976 included iron and steel, iron ore, and nonferrous metals.

Trade statistics for mineral commodities in 1974 and 1975 are shown in tables 2 and 3.

Table 2.—Sweden: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Alumina	5	19	West Germany 13; Denmark 5.
Metal including alloys:			
Scrap	1,796	1,250	West Germany 789; Netherlands 215.
Unwrought	11,765	8,019	Norway 6,576.
Semimanufactures	50,674	31,955	Denmark 7,906; Norway 5,892; Finland 5,139; United Kingdom 4,852.
Arsenic, oxides and acids --value, thousands--	$11,846	$3,059	NA.
Chromium ore and concentrate	80	NA	
Cobalt oxide	(1)	NA	
Copper:			
Ore and concentrate	33,855	9,820	East Germany 8,959.
Matte	220	NA	
Metal including alloys:			
Scrap	353	932	France 584; West Germany 148; Belgium-Luxembourg 136.
Unwrought	20,632	22,202	United Kingdom 6,235; West Germany 5,368; Finland 4,316; France 2,667.
Semimanufactures	53,015	46,308	Norway 10,081; Denmark 5,968; United States 5,772; Algeria 5,000.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons--	33,105	23,081	West Germany 5,463; Belgium-Luxembourg 4,988; Netherlands 3,980; United Kingdom 2,742.
Roasted pyrite ---------do----	418	430	United Kingdom 307; West Germany 82.
Metal:			
Scrap ---------do----	11	11	West Germany 7; Belgium-Luxembourg 2; Denmark 2.
Pig iron [2] ---------do----	313	283	Italy 98; United States 55; Finland 38.
Ferroalloys ---------do----	85	67	United Kingdom 23; West Germany 17; United States 7.
Steel, primary forms ---------do----	189	120	West Germany 68; Denmark 22; Finland 12.
Semimanufactures:			
Bars, rods, angles, shapes, sections ---------do----	591	457	United Kingdom 80; Denmark 51; Finland 45.
Universals, plates, sheets --do----	792	737	West Germany 141; Denmark 133; Norway 84.
Hoop and strip ---------do----	92	69	Finland 8; Denmark 7.
Rails and accessories -----do----	26	25	East Germany 12; Norway 9; West Germany 3.
Wire ---------do----	82	58	United States 9; West Germany 7.
Tubes, pipes, fittings -----do----	242	200	West Germany 22.
Castings and forgings, rough do----	3	3	Denmark 1; Finland 1; Norway 1.
Lead:			
Ore and concentrate	46,690	49,520	West Germany 33,924; Belgium-Luxembourg 10,672.
Oxides	577	293	NA.
Metal including alloys, all forms	29,396	28,188	West Germany 12,005; Italy 6,495; Finland 3,511; Denmark 3,398.
Magnesium metal including alloys:			
Scrap	214	299	United States 114; West Germany 86; Netherlands 33.
Unwrought and semimanufactures	15	NA	
Mercury ---------76-pound flasks--	203	145	Denmark 58; Finland 29; West Germany 29.
Molybdenum ore and concentrate	416	884	Belgium-Luxembourg 507; United Kingdom 256.
Nickel:			
Metal including alloys:			
Scrap	622	714	West Germany 313; United Kingdom 108.
Unwrought	2,507	2,902	Netherlands 2,430; United States 385.
Semimanufactures	2,287	2,100	Brazil 393; Romania 284.

See footnotes at end of table.

Table 2.—Sweden: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Platinum-group metals and silver:			
Waste and sweepings, value, thousands	$8,980	$8,435	West Germany $3,695; United Kingdom $2,596; Norway $1,364.
Metal including alloys, unworked or partly worked:			
Platinum group, do.	$1,064	$642	Finland $468; Denmark $83.
Silver, thousand troy ounces	4,501	8,198	Norway 64; Denmark 32; West Germany 32; Mexico 32.
Silicon, elemental	14,655	9,587	East Germany 2,200; West Germany 1,872; United Kingdom 1,338; U.S.S.R. 1,008; Czechoslovakia 958.
Tin metal including alloys:			
Scrap	14	14	Norway 13.
Unwrought and semimanufactures	90	83	Netherlands 56; Finland 22.
Titanium:			
Ore and concentrate	72	NA	
Oxides	242	76	Norway 37; Finland 31.
Tungsten:			
Ore and concentrate	33	NA	
Metal	99	101	West Germany 65; Poland 10.
Zinc:			
Ore and concentrate	231,066	210,112	West Germany 79,675; Belgium-Luxembourg 48,117; Norway 45,785.
Oxide and peroxide	477	520	Norway 198; United Kingdom 171; Turkey 70.
Metal including alloys:			
Powder	84	75	Denmark 32; Norway 21; Netherlands 12; Greece 8.
Scrap	1,103	511	United Kingdom 106; West Germany 82; Norway 73; Belgium-Luxembourg 67; Italy 63.
Unwrought and semimanufactures	2,044	582	Norway 273; United Kingdom 81.
Zirconium ore and concentrate	62	14	All to Norway.
Other:			
Ash and residues containing nonferrous metals	32,526	33,663	Norway 28,239.
Oxides, hydroxides, peroxides of metals, n.e.s	59	14	West Germany 5; Netherlands 5; Brazil 3.
Base metals including alloys, all forms	913	1,296	West Germany 368; Netherlands 259; United Kingdom 241.
Unspecified	7	5	Denmark 2; Finland 1; West Germany 1.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc value, thousands	$6	$8	Finland $3.
Dust and powder of precious and semi-precious stones, do.	$4	$30	U.S.S.R. $24; Netherlands $3.
Grinding and polishing wheels and stones	2,558	2,413	West Germany 427; Finland 364; Denmark 288.
Asbestos	60	173	Norway 140; Finland 17.
Borates, crude	122	NA	
Cement, hydraulic	473,405	337,282	NA.
Chalk	9,383	7,446	Denmark 3,024; Norway 2,058; Finland 830.
Clays and clay products (including all refractory brick):			
Crude clays	1,201	966	Denmark 326; Norway 307.
Products:			
Refractory (including nonclay bricks)	37,789	29,466	Norway 8,584; Finland 6,280; Denmark 5,486.
Nonrefractory	40,913	26,916	Norway 10,253; Denmark 4,552; Finland 2,825; Belgium-Luxembourg 2,722.
Diamond:			
Gem, not set or strung, value, thousands	$3,923	$648	Finland $120; Netherlands $103; Belgium-Luxembourg $100; Denmark $96; Norway $88.
Industrial, do.	$93	$117	Netherlands $35; United Kingdom $29.

See footnotes at end of table.

Table 2.—Sweden: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Diatomite and other infusorial earth	216	124	Norway 70; Finland 33.
Feldspar, fluorspar, etc	39,412	32,157	United Kingdom 14,619; East Germany 8,679.
Fertilizer materials:			
Crude phosphatic	22,200	23,617	Norway 23,615.
Manufactured:			
Nitrogenous	88,521	56,220	East Germany 4,862; Finland 3,785; Ireland 3,389.
Phosphatic	173,041	59,287	Norway 4,953.
Potassic	—	1,803	All to Belgium-Luxembourg.
Other including mixed	19,598	7,358	Norway 6,322.
Graphite, natural	246	73	All to West Germany.
Gypsum and plasters	1,224	138	NA.
Lime	2,236	584	Norway 538.
Magnesite	1,060	84	Denmark 25; Norway 23; United States 16.
Mica including splittings and waste	5	13	United Kingdom 10.
Pigments, mineral:			
Crude	20	9	All to Sri Lanka.
Iron oxide	101	76	Finland 29; Norway 24; Belgium-Luxembourg 10.
Salt and brine	730	261	Norway 206.
Stone, sand and gravel:			
Dimension stone:			
Crude or partly worked:			
Granite, gneiss, sandstone, etc	325,581	74,517	West Germany 21,737; Italy 13,927; Japan 13,827; Denmark 9,760.
Marble and other calcareous	2,670	2,324	Denmark 1,813; Netherlands 293.
Slate	10,570	11,614	Norway 6,076; Belgium-Luxembourg 3,730.
Worked	15,273	15,066	Denmark 11,788.
Dolomite, chiefly refractory grade	4,628	3,424	Norway 1,921; Finland 749; Denmark 712.
Gravel and crushed stone—thousand tons	1,382	1,551	West Germany 791; Denmark 528; Poland 139; Norway 65.
Limestone	858,204	738,944	Finland 372,916; West Germany 243,187; Denmark 121,095.
Quartz and quartzite	124,847	91,928	Norway 50,868; West Germany 18,699.
Sand, excluding metal bearing	62,894	87,799	Norway 51,445; Poland 20,506; Denmark 11,070.
Sulfur:			
Sulfuric acid	73,075	69,730	Canada 61,252.
Sulfur dioxide	9,952	11,360	Norway 10,540.
Talc, steatite, soapstone, pyrophyllite	3,590	4,110	United Kingdom 2,896; Netherlands 524.
Other nonmetals, n.e.s.:			
Crude	19,603	9,870	Denmark 4,992; Norway 4,023.
Slag, dross and similar waste, not metal bearing	150,815	122,927	East Germany 45,939; Norway 26,712; United Kingdom 23,994; Finland 16,436.
Oxides and hydroxides of magnesium, strontium, barium	65	53	Denmark 19; Ireland 13; Brazil 7.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural	36	20	Denmark 10.
Carbon black	6,069	6,822	Finland 2,864; Norway 2,811; Denmark 756.
Coal and coke including briquets	83,056	51,354	West Germany 24,005; Finland 15,204; Denmark 8,676.
Hydrogen, nitrogen, rare gases	3,151	2,848	Denmark 2,480.
Peat including briquets and litter	18,349	18,250	Denmark 9,662; Norway 6,195.
Petroleum refinery products:			
Gasoline —thousand 42-gallon barrels	708	1,413	Denmark 587; Norway 456.
Jet fuel —do	226	249	United Kingdom 194; Denmark 40.
Kerosine —do	72	98	Norway 89.
Distillate fuel oil —do	1,747	3,466	Denmark 2,269; Norway 967.
Residual fuel oil —do	2,506	5,403	Denmark 3,916; Norway 1,052.
Lubricants —do	552	452	Norway 138; Finland 86; Denmark 84; United Kingdom 72.

See footnotes at end of table.

Table 2.—Sweden: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum refinery products—Continued			
Other:			
Liquefied petroleum gas thousand 42-gallon barrels	249	153	Norway 82; Denmark 56.
Unspecified ---do---	3,500	398	Denmark 169; Norway 123; Finland 58.
Total ---do---	9,560	11,632	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	9,069	18,019	United Kingdom 6,345; Netherlands 5,691; Belgium-Luxembourg 5,176.

NA Not available.
[1] Less than ½ unit.
[2] Includes shot, grit, spiegeleisen, etc. of iron and steel.

Table 3.—Sweden: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	97,121	68,042	Greece 39,406; Australia 12,857; Guyana 10,872.
Alumina	188,165	220,221	Jamaica 123,237; West Germany 47,191; Surinam 43,894.
Metal including alloys:			
Scrap	1,947	1,140	Romania 479; Norway 208.
Unwrought	54,360	43,772	Norway 19,983; Ghana 8,471; United Kingdom 5,030.
Semimanufactures	50,071	48,546	Norway 9,871; West Germany 7,433; Austria 6,610.
Chromium:			
Chromite	270,287	395,735	U.S.S.R. 180,574; Turkey 83,354; Finland 58,991.
Oxide and hydroxide	2,594	2,250	West Germany 1,144; U.S.S.R. 580.
Cobalt oxide and hydroxide	5	3	Belgium-Luxembourg 2; United Kingdom 1.
Copper:			
Ore and concentrate	40,360	56,387	Norway 31,155; Ireland 13,984; Canada 8,955.
Matte	3,118	6,685	France 6,666.
Metal including alloys:			
Scrap	5,036	8,485	United States 2,568; France 2,325; Finland 1,823.
Unwrought	70,399	75,003	Chile 19,217; Belgium-Luxembourg 16,221; Zambia 13,057. Canada 9,269.
Semimanufactures	27,182	28,461	United Kingdom 8,888; West Germany 5,363; Finland 3,719.
Iron and steel:			
Ore and concentrate, except roasted pyrite	82,000	319,000	Liberia 280,000; Brazil 38,000.
Metal:			
Scrap	368,234	338,144	United States 99,628; U.S.S.R. 95,996; Denmark 53,357.
Pig iron, including cast iron	216,013	223,820	East Germany 74,766; Finland 66,600; West Germany 25,742.
Ferroalloys	214,596	185,590	Norway 75,739.
Steel, primary forms	141,030	216,602	Finland 158,566; West Germany 41,625.
Semimanufactures:			
Bars, rods, angles, shapes, sections	576,079	783,618	West Germany 152,119; Belgium-Luxembourg 123,453.
Universals, plates, sheets	1,098,594	1,039,392	West Germany 185,714; Belgium-Luxembourg 166,769; Japan 160,545; Italy 133,728.
Hoop and strip	129,059	102,585	West Germany 29,843; Poland 18,592; Belgium-Luxembourg 13,155.

See footnote at end of table.

Table 3.—Sweden: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures—Continued			
Rails and accessories	3,339	5,140	West Germany 3,441; United Kingdom 820.
Wire	27,981	106,394	West Germany 64,823; United Kingdom 19,277.
Tubes, pipes, fittings	314,681	33,134	United Kingdom 9,718; West Germany 8,575; France 8,262.
Castings and forgings, rough	13,045	13,690	Poland 4,182; Norway 2,459; Denmark 1,408.
Total	2,162,778	2,083,953	
Lead:			
Oxides	1,585	2,917	West Germany 1,333; United Kingdom 1,311.
Metal including alloys:			
Unwrought	8,446	4,673	West Germany 2,180.
Semimanufactures	1,303	1,298	West Germany 861; Belgium-Luxembourg 240; Netherlands 129.
Magnesium metal including alloys:			
Unwrought including scrap	1,785	1,653	Norway 1,548.
Semimanufactures	237	116	Switzerland 47; West Germany 42.
Manganese:			
Ore and concentrate	37,870	35,113	U.S.S.R. 16,190; Gabon 12,179; Republic of South Africa 5,758.
Oxides	1,970	1,528	People's Republic of China 1,124; Japan 165.
Mercury ---76-pound flasks	2,118	1,479	U.S.S.R. 725; Italy 290.
Molybdenum:			
Ore and concentrate	8,456	6,980	United States 2,457; Netherlands 2,340; Chile 1,017; Belgium-Luxembourg 752.
Metal including alloys, all forms	71	74	United States 17; Austria 16; West Germany 16; Poland 11.
Nickel:			
Matte	1,852	2,602	Australia 1,008; Canada 712; Netherlands 610.
Metal including alloys:			
Scrap	1,056	1,927	United States 1,537.
Unwrought	13,746	13,940	United Kingdom 4,609; Norway 2,518; Australia 1,610.
Semimanufactures	6,160	6,648	Netherlands 4,398; United Kingdom 863.
Platinum-group metals and silver:			
Ore and concentrate	123	1,560	Peru 1,151; Colombia 262.
Waste and sweepings	366	154	United States 69; France 68.
Metals including alloys, unwrought or partly worked:			
Platinum group-value, thousands	$7,417	$9,064	Switzerland $3,474; West Germany $2,906; United Kingdom $1,955.
Silver ---do	$21,536	$26,576	United Kingdom $12,759; West Germany $6,629; Norway $3,416.
Tantalum ---do	$162	$210	United States $159; West Germany $27.
Tin:			
Oxide	41	41	West Germany 23; United Kingdom 15.
Metal including alloys:			
Unwrought including scrap	641	805	United Kingdom 372; Malaysia 122; West Germany 94.
Semimanufactures	255	243	United Kingdom 172; West Germany 48.
Titanium:			
Ore and concentrate	4,797	4,234	Australia 2,921; India 1,313.
Oxide	6,173	3,590	Finland 1,036; Norway 562; France 404; Netherlands 404.
Tungsten:			
Ore and concentrate	1,909	3,679	Brazil 963; People's Republic of China 861; Thailand 595; Canada 428.
Metal including alloys, all forms	34	103	West Germany 51; United States 29.

See footnote at end of table.

Table 3.—Sweden: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Zinc:			
Oxide	2,086	1,525	Netherlands 506; Norway 225; East Germany 209; Czechoslovakia 170.
Metal including alloys:			
Blue powder	663	582	Norway 547.
Scrap	444	227	Finland 162; Norway 41; Iceland 23.
Unwrought	44,625	48,357	Norway 21,865; Finland 15,456.
Semimanufactures	1,368	1,043	West Germany 556; Norway 228.
Other:			
Ores and concentrates, n.e.s	720	836	Australia 748.
Ash and residues containing nonferrous metals, n.e.s	39,533	46,295	West Germany 21,410; United Kingdom 8,596; Poland 5,904.
Oxides, hydroxides and peroxides of metals, n.e.s	2,252	1,953	Finland 510; West Germany 449; Norway 272.
Metals including alloys, all forms	7,253	9,291	Republic of South Africa 3,370; West Germany 1,322; U.S.S.R. 1,071.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc.	1,458	2,172	Iceland 1,745.
Dust and powder of precious and semiprecious stones—value, thousands	$793	$2,070	United States $1,356; United Kingdom $241.
Grinding and polishing wheels and stones	3,862	3,870	Austria 1,164; United Kingdom 1,125; United States 452; West Germany 423.
Asbestos	17,399	15,529	Canada 5,280; U.S.S.R. 4,813; Cyprus 2,722.
Barite and witherite	4,451	5,405	West Germany 4,455.
Boron:			
Crude natural borates	18,903	17,726	United States 10,695; Turkey 7,011.
Oxide and acid	790	920	France 570; United States 227.
Cement	23,637	20,187	Denmark 14,372; United Kingdom 2,834; West Germany 2,337.
Chalk	18,264	17,620	Denmark 6,708; West Germany 5,978; France 3,459.
Clays and clay products including all refractory brick:			
Crude clays, n.e.s	313,656	274,523	United Kingdom 223,232.
Products:			
Nonrefractory	28,196	32,794	Denmark 8,802; Poland 7,474; West Germany 3,972; Netherlands 3,602.
Refractory including nonclay bricks	168,946	165,026	United Kingdom 44,009; Austria 40,945; West Germany 36,525.
Cryolite and chiolite	1,540	502	All from Denmark.
Diamond:			
Gem, not set or strung value, thousands	$11,655	$12,220	Belgium-Luxembourg $6,217; Israel $2,313.
Industrial ——do	$1,605	$1,645	Republic of South Africa $745; United Kingdom $582.
Diatomite and other infusorial earth	4,808	4,147	United States 1,772; Denmark 1,001; Iceland 521.
Fertilizer materials:			
Crude:			
Nitrogenous	27,250	19,256	All from Chile.
Phosphatic	695,900	675,832	Morocco 314,503; U.S.S.R. 299,191.
Manufactured:			
Nitrogenous	516,738	655,414	Norway 569,791.
Phosphatic	26	NA	
Potassic	922	1,344	France 844; West Germany 499.
Other	93,304	104,190	Norway 86,212.

See footnote at end of table.

Table 3.—Sweden: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Fluorspar, feldspar, leucite, etc	19,320	17,845	France 7,183; People's Republic of China 3,441; Finland 2,896; East Germany 2,145.
Graphite, natural	1,271	861	West Germany 266; Austria 200; Norway 191; United Kingdom 116.
Gypsum and plasters	427,934	295,396	U.S.S.R. 120,921; Poland 104,379; Spain 59,572.
Lime	6,411	3,476	Denmark 2,532; West Germany 536.
Magnesite	7,062	2,860	United Kingdom 970; Austria 875; Netherlands 540.
Mica, all forms	1,004	738	Norway 290; India 141.
Pigments, mineral:			
Natural, crude	91	122	France 46; Austria 41; West Germany 15.
Iron oxides, processed	8,654	5,764	West Germany 5,376.
Precious and semiprecious stones except diamond ----value, thousands	$624	$914	Switzerland $351; West Germany $209.
Pyrite, unroasted	101,472	81,116	Norway 80,860.
Salt ----thousand tons	1,204	1,224	Netherlands 550; West Germany 290; United Kingdom 194.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	58,096	51,772	Belgium-Luxembourg 35,577; West Germany 13,658.
Caustic potash	2,966	1,278	West Germany 764; France 459.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Marble and other calcareous stone	1,499	760	Italy 465; Belgium-Luxembourg 222.
Slate	2,420	1,495	Norway 1,265.
Other including granite, gneiss, etc	2,840	3,412	Norway 1,648; Finland 1,187; Republic of South Africa 515.
Worked, all types	10,636	9,586	Portugal 5,057; Poland 1,489; Italy 1,358; Norway 1,034.
Dolomite	25,970	29,633	Norway 23,972; Finland 4,450.
Gravel and crushed stone	49,635	88,544	Norway 51,224; Denmark 16,533; Finland 12,683.
Limestone (except dimension)	135,595	97,487	United Kingdom 52,363; Denmark 40,987.
Quartz and quartzite	42,834	43,298	Spain 40,970.
Sand excluding metal bearing	585,024	301,007	Denmark 202,796; Belgium-Luxembourg 76,173.
Sulfur:			
Elemental, all forms	129,816	94,049	Poland 70,368.
Sulfuric acid including oleum	100,166	75,209	Finland 66,279; Norway 8,793.
Sulfur dioxide	9,001	8,752	West Germany 7,354; Norway 1,398.
Talc, steatite, soapstone, pyrophyllite	24,729	22,305	Norway 13,875; Austria 3,404.
Other nonmetals, n.e.s.:			
Crude	108,787	97,313	Norway 48,091; West Germany 39,657.
Slag, dross and similar waste, not metal bearing	419	2,968	Denmark 1,464; Netherlands 691; West Germany 382.
Oxides and hydroxides of magnesium, strontium, barium	19,288	20,981	Norway 9,991; United Kingdom 3,995; Greece 3,200; Spain 2,400.
Bromine, iodine, fluorine	24	20	Israel 10; West Germany 2; United Kingdom 2.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	883	877	Trinidad and Tobago 461; United States 415.
Carbon black	10,153	8,693	West Germany 5,434; United Kingdom 1,557; Netherlands 1,089.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	1,501	1,632	U.S.S.R. 569; Poland 299.
Lignite and lignite briquets	12,763	15,026	Poland 9,323; Yugoslavia 3,102.
Coke and semicoke ----thousand tons	1,599	1,202	West Germany 568; United Kingdom 381.
Hydrogen, helium, rare gases	1,291	1,480	Denmark 826; West Germany 543.

See footnote at end of table.

Table 3.—Sweden: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Peat and peat briquets	650	775	Finland 770.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	74,158	84,980	Iran 21,658; Nigeria 17,731; Saudi Arabia 15,078; United Arab Emirates 9,331.
Refinery products:			
Gasoline ---do---	18,319	19,245	United Kingdom 4,523; Denmark 4,442; Netherlands 2,177.
Jet fuel ---do---	1,133	1,451	Netherlands 861; United Kingdom 343.
Kerosine ---do---	1,052	1,091	United Kingdom 374; U.S.S.R. 350; Belgium-Luxembourg 153; Denmark 113.
Distillate fuel oil ---do---	46,589	43,846	United Kingdom 11,371; U.S.S.R. 8,565; Denmark 4,723.
Residual fuel oil ---do---	58,096	58,331	U.S.S.R. 20,110; Netherlands 7,488.
Lubricants ---do---	1,299	1,080	United Kingdom 329; Netherlands 250; West Germany 238; United States 140.
Other:			
Liquefied petroleum gas---do---	1,067	744	Netherlands 285; United Kingdom 137; France 111.
Naphtha ---do---	9,595	7,564	United Kingdom 1,134; Saudi Arabia 1,098; Norway 1,026; Italy 994.
Mineral jelly and wax---do---	177	153	West Germany 79; United Kingdom 21.
Petroleum coke, asphalt, and bitumen ---do---	1,263	1,033	Denmark 413; United States 333; West Germany 261.
Unspecified ---do---	784	1,166	U.S.S.R. 614; Portugal 161.
Total ---do---	139,374	135,704	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	55,643	58,208	West Germany 15,300; United Kingdom 15,114; Netherlands 8,337; Belgium-Luxembourg 6,269.

NA Not available.

COMMODITY REVIEW

METALS

Aluminum.—In 1976, the upturn in the market enabled Gränges Aluminium AB, a subsidiary of Gränges AB, and Sweden's only producer of primary aluminum, to increase metal production to 98% of its capacity. The company's 85,000-ton-per-year reduction plant was located at Sundsvall on the Baltic about 300 kilometers north of Stockholm. The company's Avesta secondary smelter, 100 kilometers northwest of Stockholm, remelted 13,000 tons of scrap in 1976, which was near its capacity.[4]

Copper, Lead, and Zinc.—In 1976, Boliden AB started regular operations at the Stekenjåkk copper-zinc mine located near the Norwegian border in Västerbotten County. The mine, leased from the Government and developed since 1973 by Boliden, was provided in 1976 with a 400,000-ton-per-year flotation plant. Adak, another mining concession, leased by Boliden from the Government and located north of Malå in Norbotten County, began to be phased out according to plans, with the closing of the Brännmyra mine. Because of the lagging economy, exploration at Boliden's mines fell slightly behind in replacing depleted reserves.[5]

SKB almost completed the rebuilding and modernization of the concentration plant at its Falun mine in Kopparberg County northwest of Stockholm. At the Falun cop-

[4] Gränges AB. Annual Report 1976, p. 6.
[5] Boliden AB. Annual Report 1976, p. 12.

per works a dust precipitator at the sinter plant and a sulfuric acid plant for smelter gases were completed.[6] AB Statsgruvor continued a large-scale drilling program at the Yxsjöberg mines, located in Örebro County west of Fagersta, and the Stollberg mines, located south of Borlänge in Kopparberg County.

In 1976, Boliden continued to account for most of the copper and lead produced in Sweden and operated the country's only large nonferrous smelter at Rönnskär near Skellefteå on the Gulf of Bothnia. At yearend, Boliden reorganized its structure. Boliden became an operating holding company controlling five Swedish subsidiaries including Boliden Metall AB and Boliden Kemi AB, which were formerly divisions of Boliden. Foreign subsidiaries of Boliden AB such as Norzinc AS, Preussag-Boliden-Blei GmbH (50% owned), and others were not affected.

Sweden's nonferrous sulfide ore mines are shown in the following tabulation:

Company and county	Name of mine	Approximate ore output (thousand tons per year)	Type of ore
Boliden AB:			
Norbotten	Aitik	8,600	Copper.
	Laisvall	1,300	Lead and zinc.
Västerbotten	Långsele	380	Zinc, copper, pyrite.
	Stekenjåkk	370	Copper and zinc.
	Udden	320	Zinc, copper, lead, pyrite.
Kopparberg	Vassbo	310	Lead.
Västerbotten	Kristineberg	270	Copper, zinc, pyrite.
	Näsliden	250	Copper and zinc.
	Rävlidmyr	220	Zinc, copper, lead, pyrite.
Kopparberg	Garpenberg-Odal	200	Zinc, lead, copper.
	Garpenberg-Norra	200	Copper, zinc, lead.
Västerbotten	Adak	190	Copper.
	Renström	160	Copper, zinc, lead.
	Långdals	110	Zinc, copper, lead.
	Rudtjebäck	110	Do.
Kopparberg	Säxberg	90	Do.
Västerbotten	Rävliden	70	Do.
Kopparberg	Gräns	60	Zinc, lead, copper.
Örebro	Ljusnarsberg	20	Copper, zinc, lead.
Västerbotten	Kimheden	1	Copper and pyrite.
Stora Kopparbergs Bergslags AB: Kopparberg	Falun	320	Zinc, copper, lead, pyrite.
Vieille Montagne: Örebro	Ämmeberg	360	Zinc and lead.
AB Statsgruvor:			
Örebro	Yxsjöberg	170	Vanadium and copper.
Kopparberg	Stollberg	180	Zinc, lead, iron.
Total		14,261	

In 1976, Vieille Montagne expanded from 300,000 tons to 600,000 tons of lead-zinc ore per year its Ämmeberg area lead-zinc mines in the Tylo Forest, at the northern tip of Lake Vättern. This made Vieille Montagne, the country's only foreign-owned mining operation, Sweden's largest zinc producer. The expansion included a new haulage shaft, ore mill, and flotation plant and permitted the closing of older facilities. Vieille Montagne, which produced about 30% of Sweden's zinc ore, exported its production to Belgium for processing at the company's smelter.

Iron Ore.—In 1976, iron ore production ran at about 80% of capacity, and deliveries reached 70%. Stockpiles at mines and docks increased to almost a 5-month mine output.

Production cutbacks enabled companies to redeploy more personnel into exploratory and preparatory operations. At LKAB's Kiirunavaara mine in Swedish Lappland, mining operations were terminated at the 420-meter level, leaving the 540-meter level as the main producer. Development continued at 775 meters and exploration at 960 meters. Modernization of the beneficiation plant continued.

At LKAB's Tuolluvaara mine near Kiirunavaara, mining was concentrated mostly on old low phosphorus iron ores. At the mine's Tuollajärvi deposit, development work was halted as ores discovered were mostly of the high phosphorus type. At the company's Leveäniemi mine near Swappavaara, about 25 kilometers southeast of Kiirunavaara, a fourth beneficiation

[6] LKAB. Annual Report 1976, p. 3.

plant was completed and plans were made to expand pelletizing capacity to 3 million tons per year. At Malmberget, development work was well advanced for the new 815-meter haulage level. At the ore loading facilities at Luleå on the Gulf of Bothnia, work continued to expand loading capacity to 10 million tons per year, and at Narvik (Norway), Kiruna's outlet on the Atlantic, construction of a new wharf and storage yard were nearing completion.

In central Sweden, operations were terminated at Surhammars Bruks AB's Eskilback, Mimer, and Kallmorberg mining areas, all in the community of Norberg near Avesta.

Ownership, name, location, and approximate output of ore and concentrates of Swedish iron ore mines in 1975 are shown in the following tabulation:

Company and mine	Location	Quantity (million tons)
Luossavaara-Kiirunavaara AB:		
Gällivare and Kokskulle	Gällivare	9.4
Kiirunavaara	Kiruna	16.7
Leveäniemi	----do	4.3
Nukutusvaara	----do	.2
Tuolluvaara	----do	1.0
Company total		31.6
Gränges Inköp AB:		
Stråssa	Lindesberg	1.3
Grängesberg	Ludvika	2.5
Company total		3.8
Stora Kopparbergs Bergslags AB:		
Dännemora and Ramhälls	Östhammar	.9
Vintjärn Fältet	Falun	.3
Blötberg	Ludvika	.4
Håksberg, Ickorrbotten, Källbotten	----do	.7
Riksberg	----do	.7
Company total		3.0
Fagersta AB:		
Riddarhytte	Skinnskatteberg	.4
Smältamosgruva	Hedemora	.1
Company total		.5
AB Svenska Kugellagerfabriken Hoforsbruk:		
Storberg and Vingesbacke	Hofors	.2
Company total		.2
Bastkärns Gruv AB:		
Bastkärn	Ljunarsberg	.2
Company total		.2
Uddeholms AB:		
Petersberg	Filipstad	.1
Company total		.1
Ställbergs Grufve AB:		
Ställberg and Haggruve	Ljunarsberg	.1
Värmlandsberg	Filipstad	.1
Company total		.2
Stripa Gruv AB:		
Stripafältet	Lindesberg	.1
Company total		.1
Surhammars Bruks AB:		
Eskilback, Mimer, Kallmorberg	Norberg	.1
Company total		.1
Idkerberg Gruv AB:		
Idkerberg	Borlänge	.1
Company total		.1

Source: Bergshantering 1975. Official Statistics of Sweden. National Central Bureau of Statistics, Stockholm, 1976.

Iron and Steel.—In 1976, production of crude steel decreased for the second consecutive year, because of the failure of the international steel market to recover. Inventories reached almost one-third of 1976 production at some mills. The difficulties of Sweden's steel industry have been growing since 1974. There was a wide-based concensus that a large-scale restructuring was essential to restore its competi-

tive position. Two official studies were made for such a reconstruction.

In the first study the specialty steel industry was analyzed. The industry's eight companies, operating 24 steelworks and employing about 36,000 workers, were covered. The proposal recommended merging of the three leading manufacturers, Gränges, Fagersta, and Avesta. It recommended a 10% cut in personnel during the next 3 years, and the merger and shutdown of unprofitable mills. The Government's participation as a partner in the steel industry was also considered.

The second study covered the commercial steel industry, composed of 10 companies operating 11 plants and employing about 18,765 people in 1976. The study recommended the closing of SKB's Domnarvet ore smelting plant and the three smaller open-hearth plants of Boxholm, NJA and Oxelösund. The plan recommended consolidating all ore smelting at NJA and Oxelösund. The plan reccommended also a reduction of the work force to 15,000.

The three largest steel producers, the only ones with ore smelting capability, accounted for 81% of the country's steel capacity. The remaining 19% capacity was divided among seven companies with only scrap smelting capability.

In 1976, because of lower steel demand, "Steelworks 80," the large Government steel project planned at Luleå on the Gulf of Bothnia, was shelved indefinitely. The plant was to have originally a 4-million-ton-per-year steel capacity, reduced later to 2.6 million tons before being shelved.

Tungsten.—Production of scheelite increased in 1976. Selective flotation tests conducted for separating scheelite from copper were encouraging. The process is intended to replace the wet-mechanical concentration process used at present at LKAB's Yxsjöberg mine located near Grängesberg.

Uranium.—LKAB continued experimentally mining a deposit of 6 million tons of Billingen alum shale at Ranstad near Skövde. In a new decision, the uranium processing experiment has been reoriented toward the recovery of all shale components including uranium, alumina, alloying metals, fossil fuels, and fertilizers. A 10-year development plan was to result in mining 1 million tons of shale per year.

NONMETALS

Cement and Limestone.—In 1976, Sweden's cement consumption declined to 7.7 million tons, and exports declined to 100,000 tons. Cementa AB, owned 95% by Industri AB Euroc and 5% by LKAB, remained the country's sole cement producer since 1973. The company controlled seven cement and four limestone plants. Adjustment to the shrinking market continued during the year. Production was reduced at the Limhamn plant in Malmö, and employment decreased by 120. The Köping plant, near Arboga, and the Stora Vika plant, near Nynashamn, were converted to coal, with the rest of the plants to follow. A decision was made to expand the Slite plant on Gotland Island with a 1.5-million-ton dry process unit by 1979. By 1980, only four plants are to handle the present output, all using the dry process.

Fertilizer Materials.—Sweden continued to import all raw materials for producing manufactured fertilizers except nitrogenous fertilizers, about half of which is produced domestically.

Svenska Salpeterverken AB operated the 54,000-ton-per-year Kvantorp and the 49,000-ton-per-year Köping ammonia plants. Uddeholms AB and Elektrokemiska AB each operated one 3,000-ton-per-year plant, located at Skoghall and Bottun.

In 1976, Sweden's agricultural sector used limestone equivalent to 650,000 tons of CaO.

Other Nonmetals.—In 1976, Sweden's sole feldspar producer, the LKAB-owned AB Forshammars Bergwerk, almost doubled sales from its Forshammar feldspar mine, located east of Kopparberg. The company purchased the Swedish Silica Works, enabling it to build up a market for silica products. Sales of quartzite from Forshammar and Ånimskog mines south of Mellerud also nearly doubled.

Sweden's only olivine producer, the Höganäs AB-owned Handöls Taljstens AB, operated its olivine mine at Handöl on the Norwegian border facing Trondheim, producing 10,000 to 20,000 tons of olivine per year for Höganäs' refractories.

Production of fluorspar concentrate continued without change at AB Stätsgruvor's Stollberg mine in Örebro County.

MINERAL FUELS

In 1976, Sweden supplied one-fifth of her energy needs domestically from hydroelectric power and fuelwood. The rest was imported petroleum, coal, and some enriched uranium fuel.

The Board of Energy Research prepared a study on Sweden's energy supply through the year 2000. In particular, the study should make it possible to decide the appropriate rate of development for nuclear power, hydroelectric power, and imports of fossil fuels including natural gas. Nuclear and hydroelectric power remain at present controversial subjects.

Supply and apparent consumption of fuels and power in 1975–76 are shown in table 4.

Table 4.—Sweden: Supply and apparent consumption of fuels and power for 1975 and 1976

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products	Black liquor, fuelwood, and waste	Hydroelectric power [2]	Nuclear power [3]
1975:						
Production [4]	12.4	0.1	--	5.2	7.1	--
Imports	51.9	2.7	47.0	--	.8	1.4
Exports	5.4	(5)	4.7	--	.7	--
Apparent consumption	58.9	2.8	42.3	5.2	7.2	1.4
1976 p:						
Production [4]	12.1	.1	--	5.3	6.7	--
Imports	57.1	3.1	51.4	--	.8	1.8
Exports	4.7	--	4.1	--	.6	--
Apparent consumption	64.5	3.2	47.3	5.3	6.9	1.8

p Preliminary.
[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Includes foreign trade of all electric power.
[3] Thermal burnoff of imported uranium fuel.
[4] Includes only primary energy.
[5] Insignificant.

Coal, Coke, and Peat.—In 1976, Höganäs AB continued to produce marginal quantities of coal near Skäne near Lake Vänern. Sweden continued to import its coal and coke requirements; however, about one-third of coke used was domestically produced. There was a modest production of peat at several locations throughout the country.

Hydroelectric Power.—In 1976, further expansion of the country's hydroelectric power was delayed. Originally the Swedish Parliament's 2-year-old energy program was to provide an additional 5 million megawatt-hours of electricity per year by 1985. Sweden's present hydroelectric installations comprise a capacity of about 12,900 megawatts.

Nuclear Power.—In 1976, nuclear power remained a controversial subject in Sweden, and there was uncertainty about the rate of future development. During 1976, there were five nuclear powerplants in operation, totaling 3,180 megawatts; one plant was to be commissioned in 1977 (the second 580-megawatt unit at Barsebäck near Malmö), and four other plants were under construction.

Petroleum.—In 1976, marginal production from small discoveries continued in the Gotland Island area. Drilling was suspended for lack of funds and further plans were under discussion.

The country's refining capacity (throughput) remained unchanged with about 20.7 million tons at six locations as shown in the following tabulation:

Company	Principal facilities and ownership	Approximate throughput (million tons per year)
Skandinavska Raffinaderi AB (Scanraff)	Lysekill (Government, Texaco Oil AB)	8.3
BP Raffinaderi AB	Göteborg (BP)	5.5
Koppartrans Olje AB	Göteborg (Shell)	5.0
AB Nynas Petroleum	Nynashamn (Rederi AB Nordstjernan)	1.4
Do	Göteborg	.3
Do	Malmö	.2

The Mineral Industry of Switzerland

By Roman V. Sondermayer [1]

In 1976, landlocked Switzerland was a producer of nonmetals, a processor of imported raw materials, and an exporter of finished products. Aluminum, steel, petroleum products, salt, and construction materials were the commodities produced. Significance of the minerals industry remained local; it contributed about 2% to the gross national product (GNP) and employed 1.4% of the total labor force. The inflation rate was about 3%. No major events related to the mineral industry were reported during 1976.

PRODUCTION

Downward trends in production continued. The mineral industry was privately owned with modern and efficient facilities. The following tabulation shows principal companies in operation in Switzerland during 1976:

[1] Physical scientist, International Data and Analysis.

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	Schweizerische Aluminium AG, plants at Steg and Chippis	80
Cement	Cement Werk Wuerenlingen, plant at Siggenthal	36
Petroleum refined	Raffinerie du Sud-Ouest S.A., owned by BP Benzin, Ente Nazionale Idrocarburi (ENI), Esso Standard (Switzerland), refinery at Collombey	40
Do	Raffinerie de Cressier S.A., owned by Shell Oil Petroleum N.V. and Gulf Oil, Great Britain, Ltd., refinery at Cressier	40
Do	Raffinerie Rheintal S.A., owned by ENI, refinery at Sennwald	20
Steel, crude	Von Roll Ltd., plant at Gerlafingen	50

Table 1.—Switzerland: Production of mineral commodities

Commodity [1] and unit of measure	1974	1975	1976 [p]
METALS			
Aluminum smelter, primary ---metric tons	87,157	79,041	78,172
Iron and steel:			
Pig iron and blast furnace ferroalloys --thousand metric tons	35	35	23
Electric furnace ferroalloys [e] ---do	[r] 6	[r] 5	5
Crude steel ---do	593	420	545
Steel semimanufactures ---do	657	354	547
NONMETALS			
Cement, hydraulic ---do	5,253	3,765	3,546
Gypsum [e] ---do	100	70	70
Lime ---do	113	73	71
Salt ---do	307	237	312
MINERAL FUELS AND RELATED MATERIALS			
Coke, gashouse ---do	40	--	--
Gas, manufactured ---million cubic feet	10,819	4,322	2,984
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	8,284	7,293	8,415
Jet fuel ---do	1,168	1,288	1,376
Kerosine ---do	31	39	39
Distillate fuel oil ---do	18,195	14,286	15,957
Residual fuel oil ---do	11,102	7,626	7,333
Other:			
Liquefied petroleum gas ---do	1,148	1,172	719
Unspecified ---do	2,158	1,558	1,467
Refinery fuel and losses ---do	2,365	1,876	1,469
Total ---do	44,451	35,138	36,775

[e] Estimate. [p] Preliminary. [r] Revised.
[1] In addition to the commodities listed, a variety of crude construction materials (common clay, sand, gravel, and stone) are undoubtedly produced, but output is unreported and available general information is inadequate to make reliable estimates of output levels.

TRADE

The mineral trade of Switzerland was not a complete reflection of activities in the mineral industry of the country. Many strictly commercial transactions in mineral commodities were recorded as imports and exports. The value of mineral imports was $2.5 billion or 19% of total imports in 1975, the latest year for which complete data were available. Fuels accounted for 54% of mineral imports. Value of mineral exports was $0.5 billion, or 4% of total exports. Tables 2 and 3 show details of Swiss foreign trade in minerals and related commodities.

Table 2.—Switzerland: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite and concentrate ——kilograms—	—	200	NA.
Oxide and hydroxide	219	145	West Germany 60; Italy 35.
Metal including alloys:			
Unwrought	23,135	22,661	Italy 8,690; West Germany 7,602; Sweden 2,760.
Semimanufactures	51,024	44,941	Nigeria 5,117; Austria 4,571; United Kingdom 4,292.
Antimony metal including alloys, all forms kilograms—	2,216	667	NA.
Arsenic trioxide, pentoxide, and acids	5	30	United States 27.
Beryllium metal including alloys, all forms kilograms—	552	130	United States 84; United Kingdom 16; West Germany 15.
Chromium oxide and hydroxide	12	4	Austria 3.
Cobalt oxide and hydroxide	—	2	Mainly to Yugoslavia.
Copper:			
Ore and concentrate ——kilograms—	—	25	NA.
Matte	1,005	151	Austria 96; Italy 45.
Copper sulfate	170	39	Austria 14; West Germany 10; France 10.
Metal including alloys:			
Scrap	15,034	6,853	West Germany 2,985; Austria 2,462; Italy 811.
Unwrought	r 4,217	3,839	West Germany 2,912; Italy 855.
Semimanufactures	10,773	9,968	United States 2,039; Israel 1,326; Austria 1,143.
Gold metal, unworked or partly worked thousand troy ounces—	1,043	735	West Germany 508; Austria 91.
Iron and steel:			
Ore and concentrate, including roasted pyrite	33	40	Italy 13; West Germany 10.
Metal:			
Scrap	116,999	117,217	Italy 103,111.
Pig iron, ferroalloys, similar materials	2,476	1,209	Italy 865; West Germany 142.
Steel, primary forms	r 1,244	27,324	Italy 20,520; West Germany 5,098.
Semimanufactures:			
Bars, rods, angles, shapes, sections	111,258	81,162	West Germany 27,904; Italy 18,825; Austria 18,390.
Universals, plates, sheets	5,438	9,322	France 2,584; West Germany 2,442; Austria 2,430.
Hoop and strip	10,459	12,029	Austria 7,080; West Germany 3,946.
Rails and accessories	3,406	2,069	Greece 546; France 354; Colombia 291.
Wire	3,435	3,104	Austria 556; West Germany 525.
Tubes, pipes, fittings	83,285	90,053	West Germany 16,779; Austria 12,777; Netherlands 8,288.
Castings and forgings, rough	946	624	West Germany 354; Austria 65; Denmark 65.
Ingots and semimanufactures, alloy steel and high carbon	14,251	18,330	Italy 8,446; France 4,244.
Lead:			
Ore and concentrate ——kilograms—	—	25	NA.
Oxides	70	71	Austria 68.
Metal including alloys:			
Scrap	9,105	5,485	Austria 2,063; Italy 1,717.
Unwrought	1,391	1,768	Italy 1,374; France 228.
Semimanufactures	56	58	Belgium-Luxembourg 30; France 10.
Magnesium metal including alloys, all forms	259	367	West Germany 145; United Kingdom 73.
Manganese oxides	11	41	United Kingdom 18; Sweden 17.
Mercury ——76-pound flasks—	141	97	Netherlands 25; France 20; Bulgaria 17.
Molybdenum metal including alloys, all forms	1	4	United Kingdom 3.
Nickel:			
Matte, speiss, similar materials	225	129	West Germany 120.
Metal including alloys:			
Scrap	843	334	West Germany 260; Italy 65.
Unwrought and semimanufactures	r 1,170	1,634	Poland 371; West Germany 227; France 175.
Platinum-group metals and silver including alloys:			
Platinum-group —thousand troy ounces—	393	428	Japan 91; Netherlands 70; France 49.
Silver ——do—	r 37,863	26,763	Italy 11,198; Austria 7,054.

See footnotes at end of table.

Table 2.—Switzerland: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Tin:			
Oxides ----------kilograms--	18	793	West Germany 738.
Metal including alloys:			
Scrap ----------	55	70	France 36; West Germany 34.
Unwrought ----------	123	52	France 40; Austria 8.
Semimanufactures ----------	r 41	39	West Germany 10; Sweden 9; Iran 8.
Titanium oxides ----------	373	114	Austria 76; West Germany 19; France 12.
Tungsten metal including alloys, all forms ---	97	19	West Germany 14.
Uranium and thorium oxides including rare-earth oxides ----------kilograms--	1,307	2,155	West Germany 569.
Zinc:			
Oxide ----------	4	12	Austria 10.
Metal including alloys:			
Scrap ----------	1,251	945	Italy 479; France 318; West Germany 99.
Blue powder ----------	217	28	Austria 20; France 7.
Unwrought ----------	587	641	Netherlands 549; West Germany 58.
Semimanufactures ----------	r 116	9	West Germany 4.
Other:			
Ore and concentrate, n.e.s ----------	193	73	Bangladesh 30; France 16; West Germany 14.
Ash and residue containing nonferrous metals ----------	24,795	22,116	West Germany 10,826; Italy 7,348.
Waste and sweepings of precious metals -	229	120	France 44; West Germany 42; Italy 22.
Oxides, hydroxides, peroxides of metals, n.e.s ----------	361	241	United Kingdom 114; Italy 69; France 26.
Metals including alloys, all forms:			
Metalloids ----------	r 11,274	7,155	West Germany 3,779.
Alkali, alkaline earth, rare-earth metals ----------kilograms--	1,609	1,074	West Germany 91; Belgium-Luxembourg 81.
Pyrophoric alloys ----------do----	2,565	865	France 734.
Base metals including alloys, all forms, n.e.s ----------	132	81	West Germany 28; Austria 11; United Kingdom 9.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc ---	16	7	West Germany 2; Italy 2.
Dust and powder of precious and semiprecious stones --------kilograms--	3,272	1,111	Italy 301; France 205; West Germany 174.
Grinding and polishing wheels and stones	970	892	West Germany 180; United Kingdom 163.
Asbestos ----------	136	82	France 60.
Barite and witherite ----------	(1)	4	All to West Germany.
Boron materials:			
Crude natural borates ----------	7	1	NA.
Oxide and acid ----------	26	58	West Germany 50.
Cement ----------	r 30,987	28,666	West Germany 21,837; Austria 4,141.
Chalk ----------	141	125	France 68; West Germany 18.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s ----------	12,239	11,123	West Germany 10,506.
Products:			
Refractory (including nonclay bricks)	r 1,139	1,458	Tunisia 506; West Germany 168.
Nonrefractory ----------	r 44,537	48,172	West Germany 18,067; France 13,911; Austria 11,259.
Cryolite and chiolite ----------	24	2	NA.
Diamond:			
Gem, not set or strung -value, thousands--	$66,371	$101,589	Israel $34,911; France $16,615; Belgium-Luxembourg $13,326.
Industrial ----------do----	$2,128	$2,006	West Germany $992; Hungary $264.
Diatomite and other infusorial earth --------	13	12	Yugoslavia 10.
Feldspar and fluorspar ----------	288	380	West Germany 227; Peru 80; Sweden 45.
Fertilizer materials:			
Crude, phosphatic ----------	2	1	NA.

See footnotes at end of table.

Table 2.—Switzerland: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Fertilizer materials—Continued			
Manufactured:			
Nitrogenous	936	424	Belgium-Luxembourg 41; Italy 40.
Phosphatic	1	34	Italy 16.
Potassic	17	1	NA.
Other including mixed	1,847	1,695	Sweden 490; West Germany 369; France 261.
Ammonia	r 80	75	Austria 63.
Graphite, natural	14	11	Iran 5; West Germany 1.
Gypsum and plasters	r 5,674	3,190	Austria 2,976.
Lime	5,210	4,185	West Germany 3,114; France 1,070.
Magnesite	r 60	33	Iran 13; France 3.
Mica:			
Crude including splittings and waste	87	44	West Germany 13; Belgium-Luxembourg 5.
Worked including agglomerated splittings	443	467	Sweden 88; United Kingdom 66; Hungary 44.
Pigments, mineral:			
Natural, crude	58	66	Peru 36; Iran 23.
Iron oxides, processed	108	35	Austria 11; United Kingdom 5; Yugoslavia 4.
Precious and semiprecious stones, except diamond:			
Natural ---value, thousands--	$85,085	$107,594	France $33,913; West Germany $16,091; United Kingdom $14,314.
Manufactured ---thousand carats--	r 236,760	233,205	U.S.S.R. 75,115; West Germany 65,760.
Pyrite (gross weight) ---kilograms--	--	48	NA.
Salt and brine	r 2,250	711	France 682.
Sodium and potassium compounds, n.e.s	r 51,025	29,063	Austria 11,229; France 8,165; West Germany 6,924.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	r 37,819	34,762	West Germany 25,692; Italy 4,822.
Worked	11,877	9,976	West Germany 8,692.
Dolomite, chiefly refractory grade	27	35	Austria 32.
Gravel and crushed rock	51,031	19,350	West Germany 9,665; France 7,729.
Limestone (except dimension)	4	1	All to West Germany.
Quartz and quartzite	39,876	27,982	Italy 23,836; West Germany 2,807.
Sand, excluding metal bearing	13,858	10,818	France 4,361; West Germany 3,178; Italy 1,742.
Sulfur:			
Elemental:			
Other than colloidal	159	5	NA.
Colloidal	7	22	NA.
Sulfur dioxide	220	1,130	West Germany 809; Austria 320.
Sulfuric acid	33,114	16,756	West Germany 5,900; Yugoslavia 5,289; East Germany 4,789.
Talc, steatite, soapstone, pyrophyllite	r 1,056	151	Italy 85; Austria 27.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet --kilograms--	--	225	NA.
Other	3,490	1,336	West Germany 763; Italy 205; France 155.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture	4,906	5,569	West Germany 4,560; France 642.
Slag and ash, n.e.s	238	119	Italy 118.
Oxides and hydroxides of magnesium, strontium, barium	22	18	Italy 4; West Germany 4; Spain 2.
Bromine, iodine, fluorine	56	43	Ireland 40.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	r 2,457	2,853	West Germany 1,045; Austria 719; France 440.

See footnotes at end of table.

Table 2.—Switzerland: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	10	12	France 11.
Carbon black and gas carbon:			
Carbon black	59	16	U.S.S.R. 5; West Germany 4; France 3.
Gas carbon	r 1	--	
Coal, all grades, including briquets	33,693	11,652	West Germany 10,395.
Coke and semicoke	47,266	13,349	West Germany 7,221; France 4,314; Belgium-Luxembourg 1,553.
Gas, hydrocarbon, manufactured	97	87	Mainly to France.
Hydrogen, helium, rare gases	63	25	Austria 12; Egypt 8.
Peat including peat briquets and litter	1,115	1,472	France 740; Austria 725.
Petroleum refinery products:			
Gasoline (including natural) thousand 42-gallon barrels	5	497	Mainly to Austria.
Distillate fuel oil ---do---	r 101	32	Austria 18; Italy 3; Yugoslavia 3.
Residual fuel oil ---do---	r 1,113	341	Austria 337.
Lubricants ---do---	r 1	1	Mainly to Poland and Austria.
Other:			
Liquefied petroleum gas ---do---	164	314	Italy 229; Austria 43; West Germany 37.
Petroleum coke ---do---	5	(1)	Mainly to West Germany.
Bitumen and other residues, and bituminous mixtures, n.e.s ---do---	8	4	Austria 1; Kuwait 1.
Unspecified ---do---	2	2	Austria 1.
Total ---do---	r 1,399	1,191	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r 5,971	467	West Germany 291.

r Revised. NA Not available.
1 Less than ½ unit.

Table 3.—Switzerland: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	15,990	20,230	France 17,168; Italy 2,737.
Oxide and hydroxide	198,438	158,074	Guinea 75,842; Australia 75,386.
Metal including alloys:			
Unwrought	41,600	16,100	Norway 5,785; Iceland 2,431; Poland 2,135.
Semimanufactures	25,285	16,435	West Germany 5,362; Austria 3,120; Norway 1,641.
Antimony metal including alloys, all forms	62	122	People's Republic of China 106; Belgium-Luxembourg 15.
Arsenic trioxide, pentoxide, acids	58	43	France 42.
Beryllium metal including alloys, all forms kilograms	725	788	United States 514.
Chromium:			
Chromite	5,002	4,232	South Africa Customs Union 1 3,554.
Oxide and hydroxide	586	443	West Germany 288; Italy 76.
Cobalt oxide and hydroxide	15	4	Belgium-Luxembourg 3.
Columbium and tantalum metal including alloys, all forms, tantalum	4	1	Mainly from United States.
Copper:			
Ore and concentrate	37	19	Mainly from Australia.
Matte	31,176	33,890	Belgium-Luxembourg 7,624; West Germany 7,212; Canada 3,679.
Copper sulfate	722	547	U.S.S.R. 325; France 124.
Metal including alloys:			
Scrap	r 1,985	4,170	United States 2,443; West Germany 800.
Unwrought	r 1,437	1,239	West Germany 794; United Kingdom 216.
Semimanufactures	r 57,100	45,651	United Kingdom 21,223; West Germany 11,241.

See footnotes at end of table.

Table 3.—Switzerland: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Gold metal, unworked or partly worked thousand troy ounces	140	121	West Germany 52; United Kingdom 31; France 14.
Iron and steel:			
Ore and concentrate including roasted pyrite	39,489	44,640	Mauritania 35,980; Italy 6,452.
Metal:			
Scrap	110,355	96,803	West Germany 79,605; Netherlands 9,402.
Pig iron and similar materials	80,739	60,944	West Germany 37,549; France 8,084.
Ferroalloys	r 27,484	11,641	Norway 2,980; West Germany 1,930; France 1,768.
Steel, primary forms	r 150,592	95,683	France 31,379; West Germany 23,705; Belgium-Luxembourg 19,164.
Semimanufactures:			
Bars, rods, angles, shapes, sections	r 486,304	291,258	West Germany 97,449; France 63,700; Belgium-Luxembourg 60,715.
Universals, plates, sheets	r 617,115	358,430	West Germany 119,187; France 83,127; Belgium-Luxembourg 37,889.
Hoop and strip	r 182,147	104,456	Belgium-Luxembourg 29,699; West Germany 29,269; Austria 17,233.
Rails and accessories	55,726	53,968	Austria 34,210; West Germany 10,939.
Wire	r 28,479	15,645	Austria 6,630; West Germany 5,207; Belgium-Luxembourg 1,748.
Tubes, pipes, fittings	170,282	75,878	West Germany 33,428; France 12,516; Italy 9,981.
Castings and forgings, rough	3,117	2,364	West Germany 705; Belgium-Luxembourg 650; France 405.
Ingots and semimanufactures, alloy steel and high carbon	165,626	116,277	West Germany 43,824; France 17,435; Italy 17,230.
Lead:			
Ore and concentrate	4	7	Mainly from Morocco.
Oxides	r 162	66	West Germany 21; Mexico 15; United Kingdom 12.
Metal including alloys:			
Scrap	46	62	France 34; West Germany 27.
Unwrought	22,378	14,355	United Kingdom 4,643; Canada 3,753; West Germany 2,114.
Semimanufactures	r 1,551	1,243	West Germany 1,158.
Magnesium metal including alloys, all forms	r 1,809	1,286	Norway 944.
Manganese oxides	730	472	Belgium-Luxembourg 151; West Germany 136; Japan 131.
Mercury 76-pound flasks	590	735	West Germany 296; U.S.S.R. 174; People's Republic of China 109.
Molybdenum metal including alloys, all forms	r 18	31	West Germany 19; Austria 6.
Nickel:			
Matte, speiss, similar materials	1,336	1,739	Norway 405; Canada 266; U.S.S.R. 245.
Metal including alloys:			
Scrap	56	160	West Germany 86; Austria 38; Sweden 25.
Unwrought and semimanufactures	r 2,251	1,836	West Germany 622; United Kingdom 587; United States 392.
Platinum-group metals and silver including alloys:			
Platinum group thousand troy ounces	r 651	538	West Germany 208; United States 79; United Kingdom 78.
Silver do	r 16,825	41,422	United Kingdom 10,689; United Arab Emirates 7,166; United States 4,779.
Tantalum metal including alloys, all forms	4	1	Mainly from United States.
Tin:			
Ore and concentrate kilograms	6	--	
Oxides	38	8	United Kingdom 6; West Germany 1.

See footnotes at end of table.

Table 3.—Switzerland: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Tin—Continued			
Metal including alloys:			
Scrap	15	9	Sweden 4; Italy 4.
Unwrought	808	727	Malaysia 208; Thailand 168; Indonesia 162.
Semimanufactures	243	152	West Germany 94; Netherlands 28.
Titanium oxides	11,139	6,258	West Germany 1,654; France 1,449; United Kingdom 991.
Tungsten:			
Ore and concentrate	60	--	
Metal including alloys, all forms	r 128	57	West Germany 29; United Kingdom 11; Ireland 9.
Uranium and thorium oxides including rare-earth oxides	14	12	France 6; Austria 3.
Zinc:			
Ore and concentrate—kilograms	480	18	NA.
Oxide	2,349	1,864	West Germany 496; France 482; Canada 229.
Metal including alloys:			
Scrap	75	40	France 20; Czechoslovakia 19.
Blue powder	2,165	2,012	Belgium-Luxembourg 899; United Kingdom 393; West Germany 206.
Unwrought	24,895	16,887	West Germany 3,364; Belgium-Luxembourg 3,296; France 1,941.
Semimanufactures	r 3,480	1,118	West Germany 486; Belgium-Luxembourg 475.
Other:			
Ore and concentrate, n.e.s	7,665	6,094	Republic of South Africa 3,554; Australia 1,493.
Ash and residue containing nonferrous metals	642	1,028	West Germany 482; France 451.
Waste and sweepings of precious metals	28	206	West Germany 193.
Oxides, hydroxides, peroxides of metals, n.e.s	6,117	2,252	West Germany 1,977.
Metals including alloys, all forms:			
Metalloids	3,712	2,894	Netherlands 1,603; West Germany 596.
Alkali, alkaline earth, rare-earth metals	r 492	269	West Germany 221; United States 45.
Pyrophoric alloys	r 17	13	Austria 9; West Germany 3.
Base metals including alloys, all forms, n.e.s	r 684	836	Republic of South Africa 473.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	r 1,512	1,020	Italy 501; West Germany 454.
Dust and powder of precious and semiprecious stones—kilograms	1,397	1,202	Ireland 710; United States 251.
Grinding and polishing wheels and stones	1,846	1,532	West Germany 648; Austria 216; Italy 155.
Asbestos	17,731	17,262	U.S.S.R. 5,429; Canada 4,172; Republic of South Africa 3,358.
Barite and witherite	3,306	1,948	West Germany 1,297; France 531.
Boron materials:			
Crude natural borates	2,236	2,480	United States 2,230.
Oxide and acid	1,005	572	Turkey 200; France 180; Italy 79.
Cement	r 166,026	126,291	Italy 69,125; France 30,868; West Germany 23,201.
Chalk	22,142	16,447	France 13,187; Italy 2,066.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s	230,269	193,687	West Germany 68,394; United Kingdom 47,875; France 40,353.
Products:			
Refractory (including nonclay bricks)	41,700	29,109	West Germany 13,639; Austria 4,582; France 3,473.
Nonrefractory	r 256,475	160,987	Italy 113,100; West Germany 29,853.

See footnotes at end of table.

Table 3.—Switzerland: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Cryolite and chiolite	1,110	840	Mainly from Denmark.
Diamond:			
Gem, not set or strung, value, thousands	$100,260	$113,759	United Kingdom $33,387; Belgium-Luxembourg $24,458.
Industrial ---do---	$3,275	$2,495	West Germany $969; Belgium-Luxembourg $617; United Kingdom $361.
Diatomite and other infusorial earth	3,230	3,231	Denmark 781; France 758; Italy 480.
Feldspar and fluorspar	18,391	9,250	West Germany 2,886; Italy 2,774; Norway 2,270.
Fertilizer materials:			
Crude:			
Nitrogenous	255	162	West Germany 110; East Germany 40.
Phosphatic	13,799	8,737	Morocco 5,684; United States 2,031; Netherlands 926.
Potassic	88,054	69,450	France 66,946.
Manufactured:			
Nitrogenous	r 45,443	31,096	West Germany 18,552; Italy 5,626; Austria 3,868.
Phosphatic:			
Thomas (basic) slag	185,992	163,289	France 106,341; Belgium-Luxembourg 55,072.
Other	9,674	3,994	France 2,251; Belgium-Luxembourg 985.
Potassic	13,612	15,291	West Germany 10,189; France 4,585.
Other including mixed	92,234	66,093	France 36,772; West Germany 14,374; Belgium-Luxembourg 8,732.
Ammonia	16,632	16,414	Austria 11,489; France 4,406.
Graphite, natural	272	179	West Germany 90; Austria 47; Norway 11.
Gypsum and plasters	119,870	79,731	West Germany 44,829; France 14,656; Austria 11,481.
Lime	r 51,937	25,776	Italy 15,182; West Germany 10,110.
Magnesite	4,114	3,793	Austria 3,695.
Mica:			
Crude including splittings and waste	695	493	West Germany 260; India 147; United Kingdom 57.
Worked including agglomerated splittings	345	622	France 445; Belgium-Luxembourg 165.
Pigments, mineral:			
Natural, crude	304	340	West Germany 130; Austria 78; United Kingdom 59.
Iron oxides, processed	3,880	1,962	West Germany 1,834.
Precious and semiprecious stones, except diamond:			
Natural ---thousand carats---	284,935	217,700	United States 62,050; Brazil 55,345; West Germany 43,655.
Manufactured ---do---	97,820	40,180	United States 36,305.
Pyrite (gross weight)	45,009	32,081	Mainly from Italy.
Salt and brine	2,261	2,143	France 1,878.
Sodium and potassium compounds, n.e.s	9,023	8,826	Italy 3,086; France 2,523; West Germany 1,953.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	r 118,227	145,930	West Germany 103,397; Italy 22,286.
Worked	r 67,292	54,812	Italy 43,272.
Dolomite, chiefly refractory grade	r 15,699	12,474	Italy 9,180; France 2,407.
Gravel and crushed rock, thousand tons	r 5,613	4,061	France 2,300; West Germany 877; Italy 597.
Limestone (except dimension)	r 30,048	7,027	France 6,709.
Quartz and quartzite	16,604	15,321	Italy 12,060; West Germany 3,003.
Sand, excluding metal bearing, thousand tons	1,755	1,097	Italy 587; France 232; West Germany 174.
Sulfur:			
Elemental:			
Other than colloidal	44,072	27,816	West Germany 25,202.
Colloidal	358	261	West Germany 145; France 115.
Sulfur dioxide	34	29	Italy 26.
Sulfuric acid	r 2,125	1,843	France 813; West Germany 652; East Germany 289.

See footnotes at end of table.

Table 3.—Switzerland: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Talc, steatite, soapstone, pyrophyllite	14,018	9,216	Austria 5,672; France 1,469; Italy 921.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet—kilograms	300	2	NA.
Other	r 57,917	36,406	West Germany 21,044; France 6,679; Netherlands 3,653.
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture	r 56,445	12,144	France 8,445; Italy 3,301.
Slag and ash, n.e.s	14,404	15,563	West Germany 14,814.
Oxides and hydroxides of magnesium, strontium, barium	450	282	Spain 74; United Kingdom 56; France 42.
Bromine, iodine, fluorine	2,706	2,540	France 832; United Kingdom 706; Israel 573.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	r 27,994	20,610	Austria 8,934; West Germany 7,307.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,835	1,995	France 1,070; Trinidad 801.
Carbon black and gas carbon:			
Carbon black	8,836	5,723	West Germany 2,522; Italy 1,544; France 933.
Gas carbon	34	25	All from West Germany.
Coal, all grades including briquets	334,215	180,165	West Germany 108,569; Poland 39,415.
Coke and semicoke	200,898	141,157	West Germany 104,738; France 26,801.
Gas, hydrocarbon, manufactured	1	1	NA.
Hydrogen, helium, rare gases	2,867	1,351	France 621; West Germany 619; Italy 69.
Peat, including peat briquets and litter	60,816	60,789	West Germany 58,386.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	45,059	32,750	United Arab Emirates 12,849; Nigeria 6,200; Kuwait 4,031.
Refinery products:			
Gasoline (including natural)—do	12,961	15,168	France 3,789; Italy 3,560; West Germany 3,454.
Distillate fuel oil—do	r 4,691	5,822	Italy 2,400; West Germany 1,089; France 831.
Residual fuel oil—do	r 32,541	33,065	France 9,457; Netherlands 6,727; West Germany 5,703.
Lubricants—do	r 8	4	West Germany 1; France 1; Belgium-Luxembourg 1.
Other:			
Liquefied petroleum gas—do	r 3,905	6,014	Netherlands 5,426.
Petroleum coke—do	299	473	United States 312; Italy 109.
Bitumen and other residues and bituminous mixtures, n.e.s—do	1,275	1,137	France 698; West Germany 224; Italy 113.
Unspecified—do	r 219	173	West Germany 59; France 52; Netherlands 45.
Total—do	r 55,899	61,856	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	39,539	32,406	West Germany 7,118; Netherlands 6,586; France 6,416.

r Revised. NA Not available.

[1] Includes Botswana, Lesotho, Swaziland, and Territory of South-West Africa.

COMMODITY REVIEW

METALS

Aluminum.—The Swiss aluminum industry started to recover from a recession during the second half of 1976, although the total output of the three aluminum plants was slightly lower than in 1975. Most of the domestic aluminum was consumed in the country. Apparent consumption in thousand tons follows:

Year	Quantity
1970	90.7
1974	105.0
1975	r 84
1976	e 96.5

e Estimate. r Revised.

Two Swiss Aluminium Ltd. (Alusuisse) plants (one in Chippis, Valais, and the other in Steg, Valais) and one owned by Usine d'Aluminium in Martigny operated during 1976. Switzerland was not a producer of bauxite and alumina, but imported alumina from Surinam, Guinea, and Australia.

Other Metals.—Four steel plants, located at Bodio (Monteforno Acciaerie e Laminatori S.A.), Lucerne (AG der von Moosschen Eisenwerke), Gerlafingen (Von Roll Ltd.), and Wöhlen (Ferrowöhlen AG) (aggregate capacity 700,000 tons), produced about 547,000 tons of steel, or about 22% of domestic demand. A large number of steel traders distributed domestic and imported steel to consumers. Some steel traders had elaborate facilities for decoiling, slitting, and other methods for preparing steel to the customer's desired specification.

Two ferrosilicon plants, situated in Bodio, were in operation during 1976. Monteforno Acciaerie e Laminatori operated an 8,000-ton-per-year plant, and Gothardwerke für Electrochemische Industrie operated an 800-ton-per-year plant. Data on output of ferrosilicon in the country were not published.

NONMETALS

Switzerland produced cement, lime, sand, gravel, gypsum, and salt; output was of domestic significance only.

Fifteen cement plants, with 6 million tons per year of installed capacity, operated at 62% of capacity during 1976. In addition, four clinker-grinding plants were in operation. The largest producer of cement was Cement Werk Wuerenlingen with a plant at Siggenthal.

Production and consumption of other construction materials reflected the general status of the Swiss economy and followed the general trend of cement.

MINERAL FUELS

Except for some hydropower (about 3% of total demand) and noncommercial fuels, Switzerland depended on imports to meet its demand for fuels. The apparent consumption of fuels and power for 1974 and 1975 is shown in table 4. Petroleum, all imported, remained the principal fuel and accounted for about 77% of the country's fuel consumption. Three petroleum refineries, with an annual capacity of 6.8 million tons, were in operation during 1976 and operated at 60% of rated capacity. The petroleum refinery at Collombey, operated by Raffinerie du Sud-Ouest S.A., and the refinery at Cressier, operated by Raffinerie de Cressier S.A., accounted for about 80% of petroleum refinery output.

There was a modest exploration effort for gas and petroleum in Switzerland during 1976, but no drilling activity was reported. Geophysical work was in the general areas of Zurich and Lucerne. Most of the exploration was related to the Molasse Formation of Miocene age. Domestic capital with some participation of large oil companies financed exploration.

Three nuclear powerplants were in operation (1,000 megawatts electric), two were under construction (1,862 megawatts electric), and two were on order (2,065 megawatts electric).

Table 4.—Switzerland: Supply and apparent consumption of fuels and power for 1974 and 1975

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Fuelwood	Hydroelectric power	Nuclear power
1974:							
Production	4.4	--	--	--	(2)	3.6	0.8
Imports	22.7	0.3	20.7	0.9	(2)	.8	NA
Exports	1.5	(2)	.3	--	(2)	1.2	NA
Apparent consumption	25.6	.3	20.4	.9	(2)	3.2	.8
1975:							
Production	4.9	--	--	--	(2)	4.1	.8
Imports	20.0	.2	18.1	1.0	(2)	.7	NA
Exports	1.1	(2)	.2	--	(2)	.9	NA
Apparent consumption	23.8	.2	17.9	1.0	(2)	3.9	.8

NA Not available.
[1] 1 ton of standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Less than 0.005 million tons of SCE.

The Mineral Industry of Taiwan

By E. Chin [1]

Taiwan's gross national product (GNP) for 1976 was estimated at $17.1 billion [2] at current prices and at $9.9 billion at 1971 prices, compared with $14.7 billion and $8.9 billion, respectively, for 1975. In absolute values, the growth in GNP for 1976 was 6.1%, compared with 5.5% in 1975 and 2.7% in 1974. The higher costs for fuels and other raw materials caused a slowdown in the economy during 1973–74. However, during 1975 and 1976, the real growth in Taiwan's GNP was approaching the average annual growth rate of 7.3% recorded during the 1953–76 period. The growth in the nation's economy was led by the manufacturing sector, which was up 18%; followed by utilities, 16.5%; and mining, 15.7%. The construction and transportation-communication sectors grew 10.2%, with services following at about 7%. Growth in the agricultural sector was 5.3% owing to favorable weather conditions that resulted in a rice harvest of 2.7 million tons. The monthly average in industrial production was up 23.7% over the 1975 average, compared with 5.8% in the prior year.

Because of the general sluggishness in the worldwide economy, competition in the foreign market was severe, frequently resulting in price reductions to maintain business volume for the country's export-oriented industries. On the other hand, the higher cost of imports during the year was a significant factor in pushing up domestic price levels. The overall increase in prices during 1976 was 4.5% at the wholesale level and 3.1% at the consumer level. Despite the competitiveness in both domestic and foreign markets, there was only moderate inflation in 1976. Wages increased about 15% during the year. The index of average industrial wages (1973=100) in 1976 was 186.2, compared with 158.7 in 1975 and 134.2 in 1974. However, the inflationary effect of higher wages was partially offset by a corresponding increase in labor productivity. The index of average labor productivity (1973=100) increased 15.9% to 140.8 in 1976.

At the end of 1976, Taiwan had about 375,000 factories and businesses, of which more than 56,000 were engaged in manufacturing. Electronic plants numbered around 720, employing about 135,000 people. The largest industry was textiles, which relied on imported cotton, principally from the United States. However, Taiwan's growing petrochemical industry was producing more feed materials for synthetic fibers and plastics.

After a 2-year decline, foreign investment in Taiwan took an upturn in 1976 and approved investments increased 19.71% from $118.2 million to $141.5 million. The upswing was due mainly to increased investments by European and Japanese concerns. U.S. investments were down from $41.2 million in 1975 to $21.8 million in 1976.

The value of Taiwan's processing activities of imported minerals and metals overshadowed the value of indigenous extraction. In 1976, the mineral-processing sector outweighed the domestic mining sector 18 to 1 in output value compared with a 16-to-1 ratio in 1975. The total industrial input into the GNP in 1976 was $5.2 billion and by sector was constituted as follows, in million dollars: Manufacturing,

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[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from New Taiwan dollars (NT$) to U.S. dollars at the rate of NT$38=US$1.00.

3,848; construction, 759; utilities, 344; and mining, 297.[3]

A breakdown by value of output for certain mineral-related sectors, in million dollars, follows:

Industrial sector	1975	1976
Mining:		
Crude oil and natural gas	99	116
Coal	102	115
Metals	25	27
Evaporated salt	4	7
Miscellaneous nonmetals	25	32
Manufacturing:		
Chemical products	2,076	2,563
Oil and coal products	1,016	1,462
Basic metals	479	614
Nonmetallic mineral products	422	535
Metal products	137	175
Total	4,385	5,646

Coal, natural gas, and limestone (including marble), ranked by value, remained the three leading mineral products mined in Taiwan. However, output of these minerals was not significant in terms of the world market. Other economically important minerals included copper, dolomite, gold, salt, sulfur, and talc. The reserves of the principal minerals in Taiwan were estimated at yearend 1976 as follows, in million tons: Asbestos, 0.75; copper ore, 14.8; dolomite, 119.8; gold ore, 6.9; limestone, 455,000; marble, 299,777; pyrite, 1.8; sulfur, 2.4; and talc, 2.4. Reserves of mineral fuels were coal, 215 million tons; petroleum, 2.5 million kiloliters; and natural gas, 28.8 billion cubic meters.[4]

Taiwan's new 6-year economic development plan (1976–81) got underway in 1976. The objectives of the plan were to improve the nation's economic structure, promote modernization, expedite development of resources, and strengthen the country's ability to adapt to change. The goals established for growth in the economy included increasing the GNP 7.5% annually to $22.3 billion in 1981, increasing the real national income from $11.3 billion in 1976 to $17.6 billion in 1981, and increasing the per capita income from $700 to $1,400 in 1981. The input of the agricultural sector to the GNP would decline from 14% to 10.5%, while that of industry would increase from 43.7% to 47.5%. Electric power capacity would increase from 5.3 million kilowatts to 9.6 million kilowatts during the 6-year plan. The total volume of trade was targeted to increase nearly threefold. Farm employment was to drop while employment in industry and services was slated to increase. Generally, the living standard would be raised 23.3% in terms of per capita income.

In the 1970's, the Government initiated a program to be completed by the end of the decade to bring Taiwan into the ranks of developed countries. This plan, called the Ten Major Construction Projects, was estimated to cost about $7.0 billion, adjustable upward owing to inflation. By yearend 1976, Taiwan Shipbuilding Corp. had essentially finished the construction of its shipyard at Kaohsiung that would have an annual vessel construction capacity of 1.5 million tons of total displacement. Construction of the first stage of Taiwan's integrated steel mill was about 50% complete at the end of 1976. When the facility is completed in 1979, annual production capacity will be 1.5 million tons of steel ingot. Projects involving the petrochemical industry included expanding the production of basic petrochemical raw materials and the production of intermediate and consumer products. Expansion of capacity to produce basic materials was essentially completed by yearend; that for xylene production, about 40% complete; for acrylonitrile, 45%; and for caprolactum, 90%. Construction of generator No. 1 of Taiwan's first nuclear powerplant was about 85% complete at the end of 1976. Generation from this 636,000-kilowatt unit was expected in early 1978. Construction of a second unit with identical capacity was about 55% complete. During the year, construction of a second nuclear plant with two 985,000-kilowatt units was initiated on the coast of northern Taiwan. A third plant with two units of 950,000 kilowatts each was also proposed as part of this nuclear energy project.

The remaining six projects were concerned with transport. Estimated construction status of these follows: Taichung harbor, 85% complete; Suao port, 35% complete; westcoast mainline railroad electrification, 50% complete; extension of the westcoast mainline railroad from Suao to Hualien, 25% complete; the north-south freeway linking Keelung and Kaohsiung,

[3] Industry of Free China. No. 1, July 1977, pp. 44–45.

[4] Mining Research and Service Organization (Taipei). Mineral Resources Development in Taiwan, China. July 1977, p. 1.

65% complete; and Taoyüan International Airport, 40% complete.

During 1976, Taiwan's total supply of energy was estimated at 23.0 million kiloliters, expressed in oil equivalent. Production from domestic fuels accounted for about 24% of the total and by sector was as follows: Coal, 42%; natural gas, 33%; hydroelectric power, 21%; and crude oil, 4%. Imports provided 76% of the country's energy supply and were distributed as follows: Crude oil, 83%; petroleum products, 16%; and coal, 1%.

Taiwan's industries consumed 18.4 billion kilowatt-hours of electricity in 1976. Estimated breakdown of consumption in the mineral-related industries was as follows, in million kilowatt-hours: Iron and steel, 1,726; cement, 1,127; metal products, 523; chemical fertilizers, 472; aluminum, 334; mining and quarrying, 364; basic industrial chemicals, 1,236; and other chemical products, 2,519.

In July 1977, two typhoons struck Taiwan, causing widespread damage. The power supply to many industries was cut off completely and then subsequently restricted for a month. Because of the damage, the Government initiated measures aimed at stimulating the economy and also began to reevaluate the targets for industrial production as set forth for the second year of the current 6-year plan.

PRODUCTION

By value, coal was the most important mineral commodity mined in Taiwan. Output of bituminous coal in 1976 increased 3% to 3.2 million tons valued at $115 million. Crude petroleum production was only 247,232 kiloliters, a 15% increase over that of 1974. The principal significance of indigenous oil was as a very small supplement to imported crude oil in the production of refinery products. Production of natural gas increased 17% to 1.8 billion cubic meters. While output was of little consequence by world standards, natural gas production was important to the domestic economy.

The value of Taiwan's principal mine products in 1976 follows, in million dollars: Copper ore, 22.4; limestone, 18.0; marble, 12.0; salt, 6.8; and gold and silver, 4.4. The value of mine output of asbestos, dolomite, gypsum, pyrite, sulfur, and talc collectively totaled $2.0 million.

Production of pig iron and crude steel ingot in 1976 increased 57% and 15%, respectively. Overall output in iron and steel products showed an increase owing to the demand in both domestic consumption and export shipments. Output of iron and steel semimanufacturers in 1976 follows, in metric tons (1975 production is in parentheses): Rods and bars, 931,273 (665,141); sections, 377,863 (291,277); tubes and pipes, 140,282 (108,265); ball, 2,387 (1,474); cable, 11,915 (8,758); and cast iron pipe, 59,908 (31,543).

Production of primary aluminum metal dropped 9% to 25,512 tons. The aluminum industry continued to be plagued by higher production costs primarily because of electrical energy consumed. Mine copper output was nearly 2,500 tons and smelter production was about 12,000 tons in 1976. Limestone production, principally for cement manufacture, totaled 9.6 million tons, up slightly over that of 1975. Cement production, however, increased 29% to 8.7 million tons in 1976. The production levels for compound fertilizer, urea, and ammonium sulfate were up over the 1975 output.

Table 1.—Taiwan: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum:			
Alumina, gross weight	45,000	46,400	47,700
Metal, primary	31,320	28,111	25,512
Sheet	16,426	17,705	18,617
Copper:			
Mine output, metal content	2,500	1,900	2,000
Metal, refined, secondary	9,859	8,539	11,660
Gold metal, primary ---troy ounces--	[r] 22,850	22,110	26,952
Iron and steel:			
Iron ore and concentrate	[(2)]	[(2)]	--
Pig iron	111,143	66,840	104,829
Ferroalloys (ferrosilicon)	27,180	23,178	15,761
Crude steel	569,563	519,991	597,082
Silver metal, primary ---troy ounces--	32,832	6,192	99,969
NONMETALS			
Asbestos	[r] 2,957	1,737	853
Cement, hydraulic ---thousand tons--	6,171	6,796	8,749
Fertilizer materials:			
Manufactured: ---do----	178	177	191
Urea (46% N) ---do----	482	483	570
Ammonium sulfate (21% N) ---do----	37	31	11
Nitrochalk (20% N)			
Compound fertilizer (20% N, 5% P_2O_5, 10% K_2O) ---do----	190	255	263
	234	207	195
Calcium superphosphate (18% P_2O_5) ---do----	349	135	389
Ammonia, anhydrous			
Gypsum:	1,532	633	1,578
Precipitated	2,443	3,054	720
Other ---thousand tons--	155	146	164
Lime			
Pyrite and pyrrhotite (including cupreous): [3]	[r] 11,059	14,175	9,386
Gross weight	4,200	5,400	3,600
Sulfur content [e] ---thousand tons--	368	268	497
Salt, marine			
Sodium and potassium compounds:	89,656	79,891	91,922
Caustic soda	59,739	67,274	74,358
Soda ash			
Stone: ---thousand tons--	135	136	172
Dolomite ---do----	8,956	9,479	9,612
Limestone ---do----	313	532	1,245
Marble, decorative	3,310	5,462	5,470
Sulfur, elemental, native other than Frasch [4]	13,517	12,050	15,481
Talc and related materials, soapstone			
MINERAL FUELS AND RELATED MATERIALS			
Carbon black [e]	200	200	200
Coal, bituminous ---thousand tons--	2,934	3,141	3,236
Coke ---do----	187	201	228
Gas, natural: [5]			
Gross production ---million cubic feet--	56,034	55,604	64,824
Marketed ---do----	[r] 55,373	54,702	65,014
Natural gas liquids:			
Liquefied petroleum gas from natural gas ---thousand 42-gallon barrels--	[r] 639	558	628
	194	176	214
Natural gasoline ---do----	1,321	1,351	1,555
Petroleum:			
Crude ---do----	6,953	7,378	8,500
Refinery products:			
Gasoline ---do----	3,750	4,135	--
Jet fuel ---do----	152	132	918
Kerosine ---do----	10,367	10,787	15,189
Distillate fuel oil ---do----	28,782	26,028	43,067
Residual fuel oil ---do----	1,912	2,839	4,502
Other: ---do----	499	534	1,278
Liquefied petroleum gas ---do----	943	1,563	1,679
Lubricants ---do----	340	2,844	2,989
Asphalt ---do----	2,891	1,298	1,839
Other ---do----	56,589	57,538	79,961
Fuel and losses ---do----			
Total ---do----			

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the commodities listed, iron, lead, tin, and zinc may be produced, but information is not available.

[2] Revised to none.

[3] From Chinkuashih only.

[4] Excludes sulfur produced by oil refineries.

[5] Largely processed into natural gas liquids.

TRADE

Taiwan's two-way trade in 1976 totaled $15.7 billion, up 40% from that of 1975. Exports increased from $5.3 billion in 1975 to $8.1 billion in 1976. Similarly, imports increased from $5.9 billion to $7.6 billion. The largest import categories during 1976 were machinery, appliances, and electrical equipment, $1.7 billion; mineral products and liquid fuels, $1.4 billion; food products, $817 million; chemicals, $739 million; and base metals, semimanufactures, and articles, $717 million. By value, shipments from Japan accounted for 30% of Taiwan's total imports, followed by the United States, 28%; Kuwait, 7%; West Germany, 6%; Saudi Arabia, 4%; and Indonesia, 3%. The remaining 22% was contributed by many countries.

Textiles and articles of apparel constituted 36% of total exports, or $2.9 billion, followed by machinery, appliances, and electrical equipment, $1.5 billion; foodstuffs, $997 million; and wood products and articles, $464 million. Principal export destinations were the United States, $1.8 billion; Japan, $691 million; Hong Kong, $361 million; and West Germany, $315 million.

By cargo value, shipments to and from Taiwan's largest port at Keelung amounted to $7.5 billion in 1976. The two-way ocean shipping at Kaohsiung port totaled $6.8 billion, while that at Taipei harbor was $1.3 billion.

In 1976, the value of mineral and metal products imported represented 28% of all imports, compared with 7% for this category in total exports, reflecting Taiwan's reliance on imported raw materials and semimanufactures. Table 2 shows the principal mineral categories traded during the last 3 years, and table 3 indicates the tonnage and value of major mineral products imported in 1976.

Table 2.—Taiwan: Value of principal mineral exports and imports
(Million New Taiwan dollars)

Commodity	1974	1975	1976
EXPORTS			
Iron and steel products	4,241	4,045	4,226
Nonferrous metals	895	604	847
Cement products	462	277	463
Refined oil products	1,015	2,063	4,906
IMPORTS			
Iron and steel products	23,981	15,008	16,980
Scrap iron	3,830	2,020	1,115
Iron ore	130	101	130
Nonferrous metals	5,584	4,447	7,085
Bauxite	108	106	126
Copper ore, concentrate, matte	230	103	119
Asbestos	158	189	352
Chemical fertilizers	1,470	1,764	904
Phosphate rock	556	601	512
Sulfur	411	328	188
Crude oil	27,257	23,732	40,025
Refined petroleum	5,080	5,849	7,802

Table 3.—Taiwan: Selected mineral and metal imports, 1976

Commodity	Quantity (metric tons)	Value (thousand New Taiwan dollars)	Principal sources (metric tons)
Metal ores:			
Bauxite and alumina	166,029	$126,146	Malaysia 151,593; Indonesia 10,000; India 4,036.
Chromite	4,579	12,395	Philippines 2,700; India 1,378.
Copper ore, concentrate, matte	8,025	119,059	Chile 5,170; Philippines 2,854.
Iron ore	151,156	129,582	India 101,977; Australia 42,735; Malaysia 6,444.
Manganese ore	41,310	84,643	Malaysia 18,580; Thailand 8,001; India 6,440; Brazil 4,485; Australia 3,321.
Metals:			
Aluminum, unwrought	36,358	1,218,877	United States 12,164; Bahrain 5,987; Japan 5,298; Ghana 3,889; Australia 3,574.
Copper, unwrought	23,736	1,267,906	Japan 9,640; Chile 6,797; Zambia 5,395; Canada 1,050.
Iron and steel:			
Steel products (excluding pig iron and ferroalloys)	NA	16,980,089	Mainly from Japan.
Ferroalloys	6,088	162,565	Republic of South Africa 4,904; Japan 1,050.
Pig iron	68,556	302,396	Japan 47,433; India 21,023.
Iron and steel scrap	297,090	1,115,261	United States 213,864; Hong Kong 56,438; Australia 18,756.
Lead, unwrought	6,341	112,081	Australia 4,711; Japan 1,051.
Platinum, unwrought	2	405,085	Mainly from Japan.
Nickel, unwrought	968	170,972	Canada 640; Japan 259; Australia 29.
Tin, unwrought	814	227,786	Malaysia 704; Indonesia 63; Japan 21.
Zinc, unwrought	26,068	773,261	Australia 15,447; Japan 7,612; Canada 2,653.
Nonmetals:			
Abrasives	2,463	35,669	Japan 1,840; United States 572.
Asbestos	19,157	352,047	Republic of South Africa 12,796; Canada 3,212; Japan 1,736.
Bentonite	3,903	19,862	United States 2,420; Japan 1,462.
Fire clay	933	13,195	Japan 668; Hong Kong 99; West Germany 94.
Graphite	5,451	105,794	Republic of Korea 4,060; Japan 1,229.
Gypsum	250,197	141,098	Japan 158,826; Republic of Korea 64,903; Mexico 22,596.
Kaolin	28,119	76,100	Republic of Korea 13,688; United States 8,876; Hong Kong 2,670.
Phosphate rock	227,578	512,172	Jordan 131,270; United States 35,612; Israel 22,166.
Salt	1,220,374	293,236	Australia 1,152,445; Austria 67,929.
Steatite	1,868	11,224	Republic of Korea 1,425; Japan 239; United States 154.
Sulfur	89,122	187,779	Canada 63,906; Japan 25,198.
Fuels and fertilizers:			
Coal	200,863	343,768	Australia 99,343; Republic of South Africa 55,508; India 36,275.
Coke	23,953	59,227	All from Japan.
Chemical fertilizers	327,026	905,494	Canada 155,425; Japan 97,194; United States 44,587.
Crude oil	12,392,047	40,024,630	Kuwait 6,695,578; Saudi Arabia 4,660,432.
Refined petroleum	2,889,681	7,802,054	Kuwait 1,664,860.

NA Not available.

Table 4.—Taiwan: Exports and reexports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Oxide and hydroxide	[2] 626	975	Republic of Korea 550; Indonesia 232; Singapore 140.
Metal including alloys, all forms	7,445	5,174	Hong Kong 1,803; Indonesia 822; Japan 581.
Beryllium metal, waste, scrap	--	353	All to Japan.
Copper:			
Ore and concentrate	708	792	Do.
Copper sulfate	10	60	Indonesia 30; Philippines 10; Malaysia 9.
Metal including alloys:			
Scrap	712	400	Mainly to Japan.
Unwrought	1,424	1,673	Japan 1,647.
Semimanufactures	4,540	4,702	Japan 1,979; Hong Kong 1,325; Singapore 534.
Iron and steel metal:			
Scrap	43,072	32,348	Japan 21,974.
Pig iron, ferroalloys, similar materials	21,639	53,883	United States 22,079; Japan 12,949.
Steel, primary forms	[r] 5,068	5,658	Thailand 2,130; Japan 1,800; Indonesia 1,251.
Semimanufactures:			
Wire rod and other bars and rods	23,185	106,074	Saudi Arabia 45,365; Indonesia 31,318.
Angles, shapes, sections	7,301	21,883	Indonesia 8,530; United States 3,043.
Universals, plates, sheets	22,077	23,676	Japan 9,286; Oman 3,439; Saudi Arabia 2,739.
Hoop and strip	6,963	13,419	Indonesia 8,002; Saudi Arabia 2,915.
Rails and accessories	115	255	Thailand 210.
Wire	4,973	8,863	United States 2,528; Saudi Arabia 1,613.
Tubes, pipes, fittings	126,378	64,312	United States 16,474; Saudi Arabia 14,973.
Castings and forgings, rough	5,041	5,316	United States 3,213; Japan 891.
Lead metal including alloys, all forms	344	932	Japan 478; Hong Kong 186.
Magnesium metal including alloys, all forms	544	247	United States 176; Japan 70.
Manganese oxides	5	1	All to Brunei.
Mercury ---76-pound flasks	--	17	All to Thailand.
Nickel:			
Matte, speiss, similar materials	35	61	Japan 42; United States 19.
Metal including alloys:			
Scrap	195	202	All to Japan.
Unwrought and semimanufactures	69	56	Mainly to Japan.
Platinum-group metals and silver:			
Waste and sweepings:			
Silver ---troy ounces	193	2,347	All to Hong Kong.
Other ---do	233,768	579	All to United Kingdom.
Metals including alloys:			
Platinum group ---do	707	3,247	Japan 3,215.
Silver ---do	707	155,545	Hong Kong 148,922.
Tin metal including alloys, all forms	34	60	Singapore 23; Hong Kong 31.
Titanium oxides	--	820	Mainly to United States.
Tungsten (wolfram) metal including alloys, all forms	2	5	West Germany 4.
Zinc:			
Oxide and peroxide	465	847	Japan 590; Philippines 148.
Metal including alloys, all forms	149	43	Malaysia 14; Indonesia 10; Philippines 10.
Other:			
Ash and residue containing nonferrous metals	29	61	All to Japan.
Oxides, hydroxides, peroxides of metals, n.e.s	57	10	Mainly to Indonesia.
Metals including alloys, all forms:			
Metalloids, silicon	--	184	Japan 100; Thailand 50; United States 20.
Alkali, alkaline earth, rare-earth metals	--	1	All to Philippines.
Pyrophoric alloys	[3]	15	All to West Germany.
Base metals including alloys, all forms, n.e.s	16	10	Mainly to Japan and Hong Kong.

See footnotes at end of table.

Table 4.—Taiwan: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS			
Abrasives, n.e.s.:			
Natural:			
Pumice, emery, natural corundum, etc	32	9	Japan 6.
Dust and powder of precious and semiprecious stones—kilograms	514	--	
Grinding and polishing wheels and stones	855	778	Thailand 148; Philippines 146; Japan 139.
Manufactured: Artificial corundum	18	--	
Asbestos	--	8	All to Indonesia.
Barite and witherite	--	3	Mainly to Mozambique and Saudi Arabia.
Boric oxide and acid, borates, perborates	r 340	37	West Germany 35.
Cement—thousand tons	346	243	Saudi Arabia 150; Singapore 54.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Bentonite	130	960	All to Hong Kong.
Fire clay	30	3	Philippines 2; Thailand 1.
Kaolin	66	--	
Other	1,455	74	Hong Kong 41; Philippines 20; Thailand 9.
Products:			
Refractory (including nonclay bricks)	r 10,217	6,477	Indonesia 3,186; Malaysia 1,601.
Nonrefractory	12,157	11,447	Japan 3,376; Hong Kong 2,797; United States 1,001.
Diamond:			
Gem:			
Not set or strung—thousand carats	r 5,685	--	
Manufactured—do	145	30	Japan 15; United States 10; France 5.
Industrial:			
Unworked—do	45	--	
Manufactured—do	5	--	
Diatomite and other infusorial earth	2	31	Mainly to Indonesia.
Feldspar and fluorspar	231	130	Indonesia 80; Malaysia 50.
Fertilizer materials:			
Manufactured:			
Nitrogenous	r 3,500	1	All to Hong Kong.
Potassic	--	2	All to Vietnam.
Other, including mixed	4,599	16	Hong Kong 8; South Vietnam 8.
Ammonia	206	85	Malaysia 59; Vietnam 26.
Graphite, natural	44	314	Japan 270; Hong Kong 44.
Gypsum and plasters	150	210	Indonesia 164; Philippines 25; Singapore 20.
Lime	1,566	4,893	Hong Kong 4,783.
Magnesite—kilograms	41	--	
Mica, all forms	7	(3)	All to United States.
Pigments, mineral: Iron oxides, processed	20	48	Saudi Arabia 33; Philippines 10.
Precious and semiprecious stones, except diamond:			
Natural—kilograms	r 5,182	12,252	United States 8,359; Hong Kong 1,414.
Manufactured—do	r 1,275	10,731	United States 5,051; West Germany 2,279.
Salt and brine	400	6,600	Hong Kong 6,350.
Sodium and potassium compounds, n.e.s	14,286	14,694	Indonesia 7,804; Hong Kong 2,393.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	17,812	5,477	Japan 5,115.
Worked	r 37,751	12,104	Japan 11,049.
Dolomite, chiefly refractory grade	2,602	1,175	Indonesia 500; Philippines 460; Malaysia 200.
Gravel and crushed rock, n.e.s	124,100	53,052	Japan 42,727; Ryukyu Islands 10,000.
Limestone (except dimension)	364	1,201	Mainly to Hong Kong.
Quartz and quartzite	r 35	1	All to Japan.
Sand, excluding metal bearing	213	31,129	Japan 20,928; Ryukyu Islands 10,000.
Sulfur:			
Elemental:			
Other than colloidal	20,426	1,188	Indonesia 953; Philippines 165.
Colloidal	142	91	Indonesia 35; Hong Kong 31; Philippines 25.
Sulfuric acid and oleum	r 31,533	2,278	Hong Kong 1,749.

See footnotes at end of table.

Table 4.—Taiwan: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Talc, steatite, soapstone, pyrophyllite	538	457	Indonesia 285; Thailand 154.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet	(3)	10	All to Singapore.
Other	283	139	Japan 70; Hong Kong 28; Malaysia 25.
Slag, dross, similar waste, not metal bearing: Slag and ash, n.e.s	3,481	2,616	Singapore 2,405.
Oxides and hydroxides of magnesium, strontium, barium	37	6	Singapore 5; Philippines 1.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	r 1,168	1,742	Hong Kong 1,197; Philippines 289.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black and gas carbon:			
Carbon black	292	134	Thailand 104; Singapore 20.
Gas carbon	2	6	All to Hong Kong.
Coal	--	1	All to Australia.
Coke and semicoke	3,147	11,310	Thailand 5,710; Indonesia 2,735; Malaysia 1,150.
Rare gases, argon ----kilograms	--	2,216	Singapore 2,060.
Petroleum refinery products:			
Gasoline ----thousand 42-gallon barrels	233	--	
Kerosine, jet fuel, white spirit----do----	61	--	
Distillate fuel oil ----do----	519	3,435	Japan 369.
Lubricants ----do----	139	194	Republic of Korea 159.
Other:			
Nonlubricating oils, n.e.s ----do----	(3)	2	Mainly to Hong Kong and Malaysia.
Pitch and pitch coke ----do----	12	307	Indonesia 301.
Total ----do----	r 964	3,938	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	126,679	40,311	Japan 38,812.

r Revised.

[1] Compiled from official Taiwan trade returns, Monthly Statistics of Trade, Republic of China, May 1975, v. 1 and May 1976, v. I.

[2] Excludes artificial corundum. See nonmetals, abrasives.

[3] Less than ½ unit.

Table 5.—Taiwan: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite and concentrate ---thousand tons--	106	114
Oxide and hydroxide	25,691	6,250
Metal including alloys:		
Scrap	8,148	5,886
Unwrought	18,338	11,573
Semimanufactures	r 5,008	2,033
Arsenic:		
Natural sulfides	16	1
Trioxide, pentoxide, acids	313	93
Beryllium metal including alloys, all forms ---kilograms--	--	34
Chromium:		
Chromite	21,173	3,467
Oxide and hydroxide	911	836
Cobalt oxide and hydroxide	18	10
Columbium and tantalum, tantalum metal including alloys, all forms ---kilograms--	6	12
Copper:		
Ore and concentrate	12,743	10,000
Matte	18	10
Copper sulfate	122	76
Metal including alloys:		
Scrap	2,324	5,662
Unwrought	22,569	19,544
Semimanufactures	9,216	9,547
Germanium metal including alloys, all forms ---kilograms--	100	2
Gold metal, unworked or partly worked ---thousand troy ounces--	r 309	80
Iron and steel:		
Ore and concentrate	143,862	143,342
Roasted pyrite	5,000	17,590
Metal:		
Scrap	785,874	407,913
Pig iron, ferroalloys, similar materials	r 58,451	8,410
Steel, primary forms	r 70,543	16,501
Semimanufactures:		
Bars, rods, angles, shapes, sections	278,840	180,035
Universals, plates, sheets ---thousand tons--	1,155	633
Hoop and strip	17,784	11,164
Rails and accessories	14,481	1,688
Wire	17,591	9,465
Tubes, pipes, fittings	65,153	58,930
Castings and forgings, rough	1,001	645
Lead:		
Oxides	r 1,123	610
Metal including alloys:		
Scrap	3,350	4,474
Unwrought	4,384	5,171
Semimanufactures	420	23
Magnesium metal including alloys, all forms	757	70
Manganese:		
Ore and concentrate	28,885	79,371
Oxides	2,875	1,543
Metal	67	16
Mercury ---76-pound flasks--	r 406,262	3,573
Molybdenum metal including alloys, all forms	217	7
Nickel metal including alloys, all forms	r 1,731	339
Platinum-group metals and silver:		
Ore and concentrate ---thousand troy ounces--	--	32
Metals including alloys:		
Platinum group ---do---	r 39	176
Silver ---do---	r 2,109	654
Selenium, elemental ---kilograms--	432	1,390
Silicon metal	477	172
Tin:		
Ore and concentrate	1	70
Oxides ---kilograms--	1	1
Metal including alloys, all forms	1,221	1,191
Titanium oxides	7,469	6,300
Tungsten metal including alloys, all forms	7	8
Uranium and thorium:		
Ore and concentrate	31	--
Oxides	17	(1)
Zinc:		
Oxide and peroxide	436	340
Metal including alloys:		
Scrap	1,446	1,425
Blue powder	93	65
Unwrought	22,277	12,307
Semimanufactures	1,088	507

See footnotes at end of table.

Table 5.—Taiwan: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS—Continued		
Other:		
Ore and concentrate:		
Of molybdenum, tantalum, titanium, vanadium, zirconium	11,446	35,498
Of base metals, n.e.s	1,121	276
Ash and residue containing nonferrous metals	7,330	4,969
Oxides, hydroxides, peroxides of metals, n.e.s	392	477
Metals including alloys, all forms:		
Metalloids, n.e.s	75	65
Alkali, alkaline earth, rare-earth metals	31	6
Pyrophoric alloys ---kilograms---	1,481	1,360
Base metals including alloys, all forms, n.e.s	139	339
NONMETALS		
Abrasives, n.e.s.:		
Natural:		
Pumice, emery, natural corundum, etc	3,714	1,046
Dust and powder of precious and semiprecious stones---kilograms---	238	131
Grinding and polishing wheels and stones	562	298
Manufactured: Artificial corundum	3,030	1,648
Asbestos	16,348	13,363
Barite and witherite	160	1,080
Boron materials:		
Crude natural borates	238	64
Oxide, acid, borates, perborates	3,861	4,229
Bromine ---kilograms---	72	255
Cement	4,647	20,141
Chalk ---kilograms---	930	--
Clays and clay products (including all refractory brick):		
Crude clays, n.e.s.:		
Bentonite	3,551	2,241
Fire clay	3,980	1,337
Kaolin	30,219	20,857
Other	48,718	35,073
Products:		
Refractory (including nonclay bricks)	7,359	33,378
Nonrefractory	r 1,135	1,618
Cryolite and chiolite	1	5
Diamond:		
Gem:		
Not set or strung ---thousand carats---	225	35
Manufactured ---do---	2,505	210
Industrial:		
Natural ---do---	3,950	825
Manufactured ---do---	r (1)	5
Diatomite and other infusorial earth	646	1,022
Feldspar and fluorspar	20,153	7,933
Fertilizer materials:		
Crude, phosphatic	251,340	210,600
Manufactured:		
Nitrogenous	123,389	132,015
Phosphatic	--	7
Potassic	r 204,868	198,894
Other, including mixed	11,655	294
Ammonia	28	2
Graphite, natural	7,471	5,825
Gypsum and plasters:		
Gypsum	86,933	111,404
Plasters	14,316	6,718
Iodine	4	3
Lime	38	(1)
Mica:		
Crude, including splittings and waste	474	219
Worked, including agglomerated splittings	440	50
Pigments, mineral:		
Natural, crude	24	20
Iron oxides, processed	2,493	1,905
Precious and semiprecious stones, except diamond:		
Natural ---kilograms---	86,594	236,212
Manufactured ---do---	12,241	2,057
Salt and brine	509,329	375,475
Sodium and potassium compounds, n.e.s.:		
Caustic soda	7,517	5,257
Caustic potash, sodic and potassic peroxides	242	354
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	448	1,612
Worked	2,888	1,636
Dolomite, chiefly refractory grade	1,626	244
Gravel and crushed rock, n.e.s	r 300	491

See footnotes at end of table.

Table 5.—Taiwan: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS—Continued		
Stone, sand and gravel—Continued		
Limestone (except dimension)	--	18
Quartz and quartzite	3,182	2,052
Sand, excluding metal bearing	1,258	343
Sulfur:		
Elemental:		
Other than colloidal	155,906	96,308
Colloidal	228,091	101,845
Sulfur dioxide	10	8
Sulfuric acid and oleum	17	5
Talc, steatite, soapstone, pyrophyllite	2,454	1,646
Other nonmetals, n.e.s.:		
Crude:		
Meerschaum, amber, jet ---kilograms--	6,054	764
Other	63,868	37,615
Slag, dross, similar waste, not metal bearing:		
From iron and steel manufacture	16,856	14,399
Slag and ash, n.e.s	9	3
Oxides and hydroxides of magnesium, strontium, barium	10,884	3,284
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	r 48	49
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	109	5
Carbon black and gas carbon:		
Carbon black	12,354	7,848
Gas carbon	11	4
Coal, all grades, including briquets	541,870	77,315
Coke and semicoke	90,200	19,720
Hydrogen and rare gases	r 78	53
Petroleum:		
Crude and partly refined ---thousand 42-gallon barrels--	r 100,473	54,977
Refinery products:		
Gasoline ---do---	51	33
Kerosine, jet fuel, white spirit ---do---	(1)	(1)
Distillate fuel oil ---do---	14,244	16,430
Lubricants (including grease) ---do---	r 368	301
Mineral jelly and wax ---do---	92	19
Other:		
Nonlubricating oils, n.e.s ---do---	68	25
Liquefied petroleum gas ---do---	1,856	1,017
Pitch and pitch coke ---do---	15	25
Petroleum coke ---do---	101	75
Bitumen and other residues and bituminous mixtures, n.e.s ---do---	(1)	(1)
Total ---do---	r 16,795	17,925
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	9,941	336

r Revised.
1 Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—Taiwan Aluminum Corp. (Talco) was the country's sole producer of primary aluminum metal. Talco was 100% Government owned and was integrated from alumina production through the metal-semifabricating stage. In September 1976, Talco completed the expansion of its alumina-aluminum facilities at Kaohsiung whereby annual primary metal production capacity was increased from 38,000 tons to 70,000 tons and alumina capacity from 76,000 tons to 150,000 tons. New rolling capacity was also added in this expansion program.

In 1976, Talco produced about 47,700 tons of alumina and 25,512 tons of primary metal ingot (down 2,599 tons from that of 1975). Manufacture of aluminum sheet was 18,617 tons; foil, 2,119 tons; and miscellaneous aluminum products, 32,322 tons. Talco produced the bulk of the sheet and foil, while China Wire & Cable Co. and Walsin Lihwa Electric Wire & Cable Corp. accounted for the bulk of the output of extrusions, castings, and semimanufactures. In 1976, the aluminum industry consumed 333.5 million kilowatt-hours of electricity.

During the year, 161,593 tons of bauxite was imported, of which 94% was from Malaysia and the remainder was from Indonesia. In addition, 4,436 tons of alumina was imported from Guyana, India, and Japan.

In July 1977, typhoon Thelma hit southern Taiwan; Kaohsiung, one of Taiwan's major seaports and its second largest city, sustained the most serious damage of the storm area. Of Kaohsiung's major industrial plants, Talco sustained the most damage. The company estimated that the cost of the damage to the facility could reach as high as $25 million.

Copper.—Output of mine copper was about 2,500 tons in 1976, all from Chinkuashih in northern Taiwan. Enargite was the chief copper mineral in the Chinkuashih auriferous copper deposit, and the grade of the ore was 0.5% to 0.8% copper. Taiwan Metal Mining Corp. (TMMC), a Government-owned company, controlled most of the copper industry in Taiwan. TMMC operated the mine at Chinkuashih and the 10,000-ton-per-year copper smelter near the mine site. In 1976, 8,025 tons of copper concentrate was imported from Chile and the Philippines for smelting. An additional 5,388 tons of copper waste and scrap was imported for refining, and domestic scrap was used also. Total production of copper metal in 1976 was 11,660 tons, compared with 8,539 tons in 1975. TMMC was considering the feasibility of establishing a 50,000-ton-per-year refinery at Taichung, equipped with a 150,000-ton sulfuric acid plant to treat foreign copper ore.

Copper requirements in Taiwan had been increasing about 20% annually since 1974. In 1976, Taiwan imported 23,736 tons of refined copper and about 10,000 tons of copper products. The country's rolling and fabricating facilities were mainly in private hands, and an important manufacture was cable and wire which was a significant export item.

Iron and Steel.—Taiwan's small magnetite placer operations were located along the northern coast between Tanshui and Wanli. Limonite workings in Tayukeng were shut down several years ago. In 1976, Taiwan imported 151,143 tons of iron ore and concentrate (primarily from India and Australia), 29,479 tons of roasted iron pyrite (mainly from the Philippines), and 35,426 tons of slag, dross, scalings, and waste.

Although Taiwan had produced from 100,000 to 150,000 tons of pig iron annually in recent years, output of steel products had been closer to 1.5 million tons. Iron ore consumption was relatively small, and domestic and imported industrial scrap and ship scrap were the principal iron raw materials. Taiwan's ship-scrapping industry was large by world standards. All types of old ships were brought in for scrapping after special materials (engines, instruments, and equipment) were first salvaged. In 1976, 1.8 million tons of ships and other vessels was imported from 25 countries for scrapping. In addition, imports of iron and steel waste and scrap metal totaled 297,090 tons, mostly from the United States.

China Steel Corporation continued construction of its integrated steelworks at Kaohsiung. The steel mill was about 60%

finished at yearend 1976, and construction was expected to be completed by late 1977. Capacity will be about 1.5 million tons of steel per year when production begins in 1978, and a planned expansion program should double capacity by 1982. The ultimate capacity is 6 million tons per year, although no date had been set to attain that output level. Initial facilities included coke and sintering plants, blast furnace and basic oxygen steel production facilities, continuous casters for billet and slab production, plate and rod and bar mills, and installations for processing, warehousing, and shipping. The requirements for iron ore and coking coal will be provided through imports.

There were about 160 small steel mills operating in 1976, producing steel products. The two largest companies were Taiwan Iron Manufacturing Corp. and Tang Eng Iron Works. The principal steel products produced in 1976 follow, in tons: Rods and bars, 931,273; structural sections, 377,863; and tubes and pipes, 140,282. Estimated electric power consumption by the iron and steel industry was 1.7 billion kilowatt-hours in 1976.

Other Metals.—Gold was produced from vein deposits at the Chinkuashih mine. No placer gold deposit was presently being worked in Taiwan. In 1976, Taiwan produced about 27,000 troy ounces of gold, a 22% increase over the 1975 output. Silver production in 1976 was about 100,000 troy ounces.

Taiwan did not produce any primary zinc, lead, tin, or nickel, but consumed sizable tonnages of these metals. In 1976, 26,068 tons of unwrought zinc, valued at $20.3 million, was imported, principally from Australia and Japan. In addition, 2,156 tons of zinc scrap was imported, mainly from the United States. Imports of unwrought lead totaled 6,341 tons, valued at $2.9 million, of which Australia supplied 74%; scrap lead imports amounted to 7,575 tons, valued at $1.8 million, of which 60% was from the United States. Imports of unwrought tin totaled 814 tons, valued at $6.0 million, most of which was from Malaysia. Imports of unwrought nickel were 968 tons, valued at $4.5 million, and were principally from Canada, Japan, and Australia, in that order.

NONMETALS [5]

Cement.—Cement production totaled 8.7 million tons, 1.9 million tons more than in 1975. Exports of cement increased sharply, reaching 543,251 tons in 1976. The principal export destinations were Hong Kong, Singapore, and Saudi Arabia. Domestic demand for cement continued to increase owing to consumption resulting from the construction in connection with Taiwan's Ten Major Construction Projects.

There were 14 operating cement plants in Taiwan—6 in the south, 6 in the north, and 2 in the east. Most of the cement plants had their own limestone quarries, and only a few small plants purchased limestone raw materials from quarries operated by others. Taiwan Cement Corp. (TCC) was the largest producer on the island with four plants—one each at Kaohsiung, Chutung, Suao, and Hualien—and a combined annual capacity of 3.8 million tons. Asia Cement Corp., with a 2.5-million-ton plant at Tahu near Hsinchu, ranked next to TCC. The remaining cement capacity, 4.7 million tons, was distributed among nine plants of eight companies.

Fertilizer Materials.—In 1976, Taiwan produced 569,598 tons of ammonium sulfate, 388,831 tons of anhydrous ammonium, 263,292 tons of compound fertilizers, 195,460 tons of calcium superphosphate, 191,475 tons of urea, and 11,114 tons of nitrochalk. Taiwan has no potash resources and only small apatite resources. During 1976, Taiwan imported 170,133 tons of potassium chloride, mainly from Canada. Imports of phosphate fertilizers were 25,264 tons, all from the United States. The remainder of fertilizer imports totaled 131,629 tons, consisting almost wholly of ammonium sulfate, and was from Japan, Australia, the United States, and others, in that order.

Gypsum.—Taiwan's production of gypsum was nominal, and the cement industry was by far the largest consumer. The bulk of the gypsum supply came from imports, which totaled 250,197 tons in 1976, principally from Japan, the Republic of Korea, and Mexico, in that order.

Salt.—All of the salt was produced by the Taiwan Salt Works, a Government monopoly. The salt fields are distributed

[5] Pages 28–34 of work cited in footnote 4.

along the southwestern coast, and crude salt was produced by solar evaporation. In 1976, salt production totaled about 497,000 tons, nearly twice the 1975 level. In 1976, imports of salt were 1.2 million tons, predominantly from Australia. One of the largest consumers of salt in 1976 was the soda-chlorine industry, which produced 91,922 tons of caustic soda (79,891 tons in 1975), 247,870 tons of liquid soda (190,892 tons in 1975), 74,358 tons of soda ash (67,274 tons in 1975), and 27,129 tons of liquid chlorine (23,633 tons in 1975).

Stone.— *Dolomite.*—Dolomite deposits are extensive and widespread, particularly in rugged and little-explored eastern Taiwan where reserves may be 120 million tons averaging 18% to 20% magnesia. Alluvial dolomite mining by hand-sorting took place in streambeds south of Hualien where flooding replenishes the supply. The most important dolomite quarries were situated along the Tachoshuichi stream north of Hualien, with lesser quarries operating near Hoping, Hojen, and Chungte. Taiwan's most promising dolomite deposit at Chingchangshan was being actively explored and developed for China Steel's integrated steelworks at Kaohsiung. Total production of dolomite in 1976 was 172,421 tons, compared with 135,952 tons in 1975. Most of the dolomite was used by the ironworks, glass manufacturers, and chemical plants.

Limestone.—Commercial limestone deposits occur in many parts of Taiwan, and large quarries were being worked, particularly in the southwest and the east. Limestone reserves had been estimated at more than 450 billion tons. Production in 1976 totaled 9.61 million tons compared with 9.48 tons in 1975. The cement industry was the largest consumer of limestone. Moreover, cement consumption was rising sharply owing to the many construction programs on the island. Considerable quantities of limestone were also used for sugar refining. Burned or calcined limestone went into lime manufacture, and high-purity raw limestone was the chief raw material for making raw carbide cyanamide fertilizer.

Marble.—The crystalline limestone in the metamorphic terrain of eastern Taiwan is classified as commercial marble. The calcareous rock is capable of being polished and is suitable for use as a decorative building stone. The marble occurrence has four color variations: White, light gray, dark gray, and light green. Mottled color patterns and shades of mixed colors also occur. Stone works and marble mills were recently installed to manufacture ornamental marble products for domestic and foreign markets. The production of marble (crystalline limestone) in 1976 totaled 3.27 million tons, compared with 1.36 million tons in 1975. Most of the demand was by the cement and fertilizer industries. The percentage of the total output of marble used as a building stone was quite small but was increasing. The output of decorative marble in 1976 was 1.2 million tons, compared with 0.5 million tons in 1975 and 0.3 million tons in 1974.

Other Nonmetals.—Sulfur production was mainly from the Kaohsiung refinery of the Chinese Petroleum Corp. (CPC). Sulfur recovery in 1976 was 5,770 tons. Pyrite production was dependent on the scale of copper mining output. Each ton of copper ore mined yielded about 176 pounds of pyrite, which could be further processed into a pyrite concentrate containing 40% sulfur. The copper operation at Chinkuashih was the leading producer of pyrite; small amounts were recovered at Chingfeng. Output of pyrite concentrate in 1976 was 9,386 tons, down 4,789 tons from the 1975 production. The bulk of the domestic demand of sulfur was supplied by imports. In 1976, 89,122 tons of sulfur was shipped to Taiwan, almost wholly from Canada and Japan.

Serpentine of commercial quality is found in the localities of Yüli and Juisui. The rock occurs in the colors of dark green, light green, and yellowish green, and with mottled color patterns. Seven operating mines, all hand-sorting fluviatile boulders along the streambeds in eastern Taiwan, produced 15,639 tons of serpentine in 1976, compared with 22,453 tons in 1975.

Asbestos and talc appear in schistose rocks in eastern Taiwan. Asbestos mining was only marginal at present. In 1976, 853 tons of asbestos was produced, down 884 tons from the 1975 output.

Talc production increased from 12,050 tons in 1975 to 15,481 tons in 1976. Most of the production was actually sericite

schist, which was used as a substitute for talc in the manufacture of insecticide. Small amounts of feldspar, which is used largely by the ceramic industry, were produced near Tungao. Mica, which is associated with the feldspar, occurs in the same pegmatite veins. In 1976, mica production totaled 448 tons, compared with 292 tons in 1975.

Glass sand deposits of commercial value are located in the white sandstone beds of coal-bearing formations at Hsinchuhsien and Miaolihsien in northwestern Taiwan. The white sandstone was crushed and ground, then washed to remove clay, rock fragments, and other impurities. The resultant pulverized sand was used directly by Taiwan's growing glass industry with only small amounts of glass sands being shipped for export. Production of glass sands in 1976 was estimated at 290,000 tons, 50,000 tons over that in 1975.

Clays, which are used in the manufacture of brick and tile, occur commonly and are widespread throughout Taiwan. They were extracted from the areas where kilns were situated. Ceramic and fire clays were produced mainly in Peitore in northern Taiwan. The clay quality is generally inferior, and high-grade clay had to be imported to blend with local clays to manufacture high-quality porcelain, pottery, and whiteware. Production of clay used in cement totaled 1.8 million tons in 1976.

MINERAL FUELS

Coal.—Coal, the most important mineral commodity mined in Taiwan, occurs mainly in northern Taiwan. The coalfields are geologically complicated, having abundant faults and folds. In some areas, the coal has been pulverized, and the hanging wall and the foot wall are weak. The beds are usually thin and steeply inclined and vary greatly in thickness. Two slopes were generally driven down along the coalbed to be mined, one serving as the intake airway and the other as the return. The common practice was to use the advancing shortwall technique combined with the room-and-pillar system.

Coal was mostly dug with hand or pneumatic coal pick. Hand-push baskets, chain conveyors, steel troughs, and chutes were used for face transportation. Hand-push mine cars and rope haulage were generally used for level transportation. There was no blasting except for rock excavation. Timber and steel supports were used at faces and on the levels.

The complexities of mining this type of coalbed formation eliminated the possibility of mechanizing the industry to any great extent. Local coal mining relied heavily on manual labor and the productivity per man-month was low, averaging 8.89 tons in 1976. During the year, 3.2 million tons of coal was mined, valued at $115 million, or 39% of the output value of Taiwan's total mining industry.

Domestic coal served as the chief fuel in powerplants, railroads, sugar mills, cement factories, ceramic kilns, and papermills. Smaller amounts of coal were used in fertilizer plants, aluminum plants, and textile mills, and in alcohol manufacture. Low-grade coking coal was converted to a semicoke for household use. Since 1965, there had been no exports of coal. In 1976, 200,863 tons of steam coal was imported, primarily from Australia, the Republic of South Africa, and India, in that order.

About 20% of the coal produced in Taiwan was classified as coking coal. Pioneer Chemical Corporation and Hsin-Chu Chemical Corporation operated the only byproduct coke plants in Taiwan; both also produced coal gas for municipal use. Both companies had exported part of their output since 1966 and in 1976 shipped 9,095 tons to Indonesia, Malaysia, Singapore, and four other Asian countries. Total production of coking coal in 1976 was 228,000 tons. The principal domestic coal-using industries were iron and steel works, carbide manufacturers, and the plastics industry. Imports of coking coal during the year totaled 23,953 tons (all from Japan), valued at $1.6 million. The domestic market for coking coal was limited. However, when China Steel's integrated iron and steel plant at Kaohsiung comes on-stream, Taiwan will need to import large tonnages of coking coal on a continuing basis.

Natural Gas.—Output of natural gas in 1976 totaled 1.8 billion cubic meters. Production was largely from the 20 producing wells in the Chinshui gasfield and from the 29 producing wells in the Tiehchenshan Field. A small amount of gas was produced at the Chutouchi Field. Field exploration

and test drilling in Taiwan indicated that the Pashatan and Yunghoshan Fields in north-central Taiwan were potential producers of commercial gas and condensate oil. Additionally, test drilling in the Paoshan Field indicated natural gas reserves in the northern part of the western basin of Taiwan. Plans were made for further exploration of the southern part of the same basin. Taiwan's reserve of natural gas was estimated at 28.8 billion cubic meters.

Petroleum.—Production of oil in 1976 was 247,232 kiloliters (about 210,000 metric tons), a 15% increase over crude production in 1975. Domestic production equaled less than 2% of crude oil imports in 1976. During the year, Taiwan imported 12.4 million tons of crude oil of which 6.7 million tons was from Kuwait, 4.7 million tons from Saudi Arabia, and the remainder from Brunei, Indonesia, Iran, and Singapore. Imports of crude oil in 1976 were valued at $1.1 billion, and refined oil imports at $205.3 million.

CPC, a Government-owned enterprise, was the sole oil company in Taiwan. CPC's refinery at Kaohsiung had a capacity of 334,500 barrels per day (multiply by 50 to convert to metric tons per year). The corporation was responsible for all phases of the petroleum industry in Taiwan from exploration, production, and refining to marketing. CPC was the sole operator for onshore oil exploration and development. However, CPC had entered into a joint-venture agreement with foreign companies on the continental shelf. During 1976, six companies held joint-venture agreements covering 98,480 square kilometers offshore: Continental Oil Co.-Amoco International, Ocean Exploration, Clinton International Ltd., Texfel Pacific Corp., Superior Oil Co., and Comoro Petroleum.

The single successful offshore hole to date was the F–1 gas-condensate discovery made by Continental Oil Co. with Amoco International, about 60 miles southwest of Taiwan in 400 feet of water. The strike indicated a well capability of 25 million cubic feet per day of gas and 250 barrels per day of condensate. The second successful strike was the CDA–1 well of CPC about 16 kilometers off the coast of Lukang in central Taiwan. The well tested undisclosed amounts of oil from a depth of about 3,600 meters from a sandstone formation. Taiwan's domestic crude oil reserves were estimated at only 24 million barrels (roughly 3.3 million tons), plus 15,000 million barrels of condensate reserves.

The Mineral Industry of Tanzania

By David E. Morse [1]

During 1976, mineral production in Tanzania was small by world standards. Diamond was the leading mineral export, followed by salt and gem stones. In general, production of minerals declined during 1976 partly as a result of the country's economic difficulties. Tanzania's foreign exchange shortage caused reduced imports of crude oil and spare parts that resulted in a fall in mineral output. No changes were made in the Government's 1974 foreign exchange control program that had suspended repatriation of all foreign business capital, earnings, and fees.

The Tanzania-Zambia Railway (TAZARA) was officially opened in July 1976, although the line had been completed in mid-1975 and some traffic had used the new rail link in late 1975. The volume of materials on the line grew steadily during 1976 and caused considerable congestion at the port of Dar es Salaam in the middle of the year, but by yearend, most of the congestion had been relieved. The line generated significant revenues during the year because a large share of the import-export traffic generated in landlocked Zambia made use of the rail link. The new railroad was expected to stimulate mineral development in southwestern Tanzania where deposits of coal, iron ore, gold, and mica have been studied.

During 1976, mineral exploration activity in Tanzania was conducted by the Geology and Mines Division of the Ministry of Water Development, Energy and Minerals, the State Mining Corp., foreign governments, the United Nations, and private industry. Teams from the People's Republic of China continued investigations of iron ore and coal deposits near the TAZARA route to determine the feasibility of establishing an iron and steel industry in Mbeya District. Studies sponsored by a consortium of Japanese companies and the Government of Tanzania were conducted to establish a soda ash industry based on the Lake Natron alkali deposits. Heavy beach sands deposits near Dar es Salaam were studied and pilot plant operations were conducted under a joint Tanzania-Romania agreement. The United Nations Development Program supported geologic surveys in the northwest, continued systematic geochemical and geophysical exploration of ultrabasic intrusive bodies with lateritic nickel potential, and began a detailed surface investigation of a large ultrabasic body in Kabanga. Systematic geologic mapping on a scale of 1:125,000 was continued by the staff of the Geology and Mines Division. Exploration for oil continued offshore without positive results; the natural gas deposit discovered in 1974 on Songo Songo Island was further evaluated during 1976.

[1] Physical scientist, International Data and Analysis.

PRODUCTION

Diamond retained its position as the most important mineral produced in Tanzania and accounted for more than 85% of the value of all minerals produced during 1976. Compared with 1975 production, diamond output dropped 2% and caused a decline in the value of all mineral production. Output of cement, precious and semiprecious stones, and salt also declined during the year.

Table 1.—Tanzania: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Gold, refined ---troy ounces--	71	[1] 78	10
Silver, refined ---do---	3	[1] 18	1
Tin, mine output, metal content	r 11	2	3
Tungsten	r (2)	--	--
NONMETALS			
Cement	296,400	266,000	241,000
Clays, kaolin	792	1,004	e 1,000
Diamond:			
Gem e 3 ---carats--	249,006	223,902	219,104
Industrial e 3 ---do---	249,007	223,903	219,105
Total ---do---	[1] 498,013	447,805	438,209
Gem stones, precious and semiprecious, except diamond: [4]			
Amethyst ---kilograms--	1,092	20	3
Aquamarine ---do---	--	5	(2)
Beryl (gem only) ---do---	76	135	46
Chrysoprase and opal ---do---	211	--	1
Corundum (gem only) ---do---	205	4	--
Garnet and rhodolite ---do---	349	69	14
Ruby and sapphire ---do---	218	2	1
Scapolite ---do---	--	13	2
Tourmaline ---do---	9	1	13
Zircon ---do---	45	7	1
Zoisite (tanzanite) ---do---	16	9	6
Unspecified ---do---	9,776	1,290	54
Gypsum and anhydrite, crude	21,124	12,839	e 12,000
Lime (quicklime and hydrated lime)	4,821	2,373	e 2,000
Meerschaum	3	--	NA
Mica, sheet	9	6	7
Salt, all types	34,177	44,390	21,880
Stone, sand and gravel:			
Calcite	2,164	5,390	NA
Ornamental stone:			
Art stone	126	3	25
Amethystine quartz	--	(2)	NA
Glass sand	14,875	28,880	NA
Vermiculite	20	--	--
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous	1,510	850	e 850
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels--	965	767	e 989
Kerosine ---do---	146	127	e 212
Jet fuel ---do---	487	411	e 420
Distillate fuel oil ---do---	2,664	2,411	e 2,585
Residual fuel oil ---do---	1,258	1,275	e 2,361
Liquefied petroleum gas ---do---	89	52	e 68
Refinery fuel and losses ---do---	213	324	e 389
Total ---do---	5,822	5,367	e 7,024

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Exports.

[2] Less than ½ unit.

[3] Estimates based on reported total diamond output and best available information on ratio of gem to industrial stones in total output.

[4] Exports, including transfers to Kenya and Uganda.

TRADE

Exports of diamond in 1976 were valued at about $19.1 million, a 1% increase compared with those of 1975. Exports of solar evaporated salt almost doubled in value to nearly $900,000, and the export value of semiprecious and precious stones increased from about $337,000 in 1975 to nearly $500,000 in 1976. Exports of petroleum products and residual oil from the refinery at Dar es Salaam were valued at $21 million.

Imports of mineral commodities and crude oil were restrained during 1976 owing to Tanzania's foreign exchange difficulties. The import value of fuels dropped 23%, that of ferrous metals declined 16%,

and that of fertilizers fell 43%. Imports of cement increased 40% and the import value of nonferrous metals increased about 27%.

Table 2.—Tanzania: Exports and reexports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys:		
Scrap	136	139
Unwrought and semimanufactures	1,359	1,076
Copper metal including alloys:		
Scrap	180	192
Unwrought and semimanufactures ----value	$438	--
Iron and steel metals:		
Scrap	771	160
Semimanufactures:		
Bars, rods, angles, shapes, sections	100	149
Universals, plates, sheets	4	16
Rails and accessories	11	9
Wire	15	27
Tubes, pipes, fittings	6,608	2,922
Lead metal including alloys:		
Scrap	292	253
Unwrought and semimanufactures ----value	--	$1,349
Manganese ore and concentrate	180	--
Tin ore and concentrate	68	40
Zinc metal including alloys, scrap	240	183
Other:		
Ore and concentrate, n.e.s	72	--
Ash and residue containing nonferrous metals	19	48
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	23	--
Dust and powder of precious and semiprecious stones	97	[2]
Grinding and polishing wheels and stones	--	4
Cement	41	954
Clays and clay products (including all refractory brick):		
Crude clays, n.e.s	76	242
Products, refractory (including nonclay bricks)	--	5
Diamond, gem, not set or strung ----thousand carats	378	595
Feldspar and fluorspar	--	6
Fertilizer materials, manufactured:		
Nitrogenous	1,281	--
Phosphatic	3,143	718
Other including mixed	35	--
Gypsum and plasters	[3] 3,704	1
Lime	10	1
Magnesite	34	--
Mica, crude, including splittings and waste	10	7
Precious and semiprecious stones, except diamond, natural ----value, thousands	$538	$379
Salt and brine	8,243	8,824
Stone, sand and gravel:		
Gravel and crushed rock, n.e.s	--	4
Quartz and quartzite	2	75
Sand, excluding metal bearing	[2]	--
Sulfur, sulfuric acid, oleum	431	372
Other nonmetals, crude, n.e.s ----value	$2,102	$3,123
MINERAL FUELS AND RELATED MATERIALS		
Coal, anthracite and bituminous	19	--
Coke and semicoke	20	7
Petroleum:		
Crude and partly refined ----thousand 42-gallon barrels	6,140	--
Refinery products:		
Gasoline ----do	176	167
Kerosine ----do	r 43	26
Jet fuel ----do	56	61
Distillate fuel oil ----do	164	147
Residual fuel oil ----do	1,343	1,308
Lubricants ----do	25	1
Other:		
Nonlubricating oils, n.e.s ----do	5	[2]
Liquefied petroleum gas ----do	5	[2]
Bitumen and other residues, and bituminous mixtures, n.e.s ----do	r [2]	[2]

r Revised.
[1] Includes transfers to Kenya and Uganda.
[2] Less than ½ unit.
[3] Includes limestone flux and similar stone used for the manufacture of lime or cement.

Table 3.—Tanzania: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys:		
Scrap	46	28
Unwrought	3,348	1,630
Semimanufactures	1,408	454
Copper metal including alloys:		
Scrap	4	8
Unwrought	15	1
Semimanufactures	[2] 284	302
Gold metal, unworked or partly worked ---troy ounces--	256	--
Iron and steel:		
Ore and concentrate	1,601	1,500
Metal:		
Pig iron, ferroalloys, and similar materials	1,099	2,666
Steel, primary forms	15,272	11,617
Semimanufactures:		
Bars, rods, angles, shapes, sections	20,942	10,747
Universals, plates, sheets	[r] 44,950	21,029
Hoop and strip	15,188	8,301
Rails and accessories	32,569	18,880
Wire	5,970	6,490
Tubes, pipes, fittings	13,283	16,587
Castings and forgings, rough	2	13
Lead:		
Ore and concentrate ---value--	--	$69
Metal including alloys:		
Scrap	--	1
Unwrought	47	32
Semimanufactures	46	8
Nickel metal including alloys, unwrought and semimanufactures --value--	$4,255	$4,431
Platinum-group metals including alloys, all forms, but not rolled troy ounces--	--	1
Silver metal including alloys, but not rolled ---do---	155	96
Tin metal including alloys:		
Unwrought	23	12
Semimanufactures	14	10
Zinc metal including alloys:		
Blue powder	2	--
Unwrought	[r] 3,683	3,732
Semimanufactures	527	132
Other, n.e.s.:		
Ore and concentrate	2	--
Ash and residue containing nonferrous metals	3	--
Metals including alloys, all forms:		
Pyrophoric alloys ---value--	$66,787	$19
Base metals including alloys, all forms	10	1
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	16	11
Dust and powder of precious and semiprecious stones	13	2
Grinding and polishing wheels and stones	44	57
Asbestos	19	70
Barite and witherite	--	308
Cement	64,909	60,361
Chalk ---value--	$32,387	$118,558
Clays and clay products (including all refractory brick):		
Crude clays, n.e.s	477	1,062
Products:		
Refractory (including nonclay bricks)	700	1,094
Nonrefractory	1,312	1,335
Diamond, gem, not set or strung ---thousand carats--	47	124
Diatomite and other infusorial earth	39	293
Feldspar and fluorspar	80	116
Fertilizer materials:		
Crude:		
Nitrogenous	297	--
Phosphatic	80,186	22,213
Potassic	--	10
Manufactured:		
Nitrogenous	25,069	39,880
Phosphatic	813	1,307
Potassic	6,179	9,032
Other including mixed	12,313	2,322
Ammonia	3,569	5,181
Graphite, natural	3	3
Gypsum and plasters	138	229
Lime	589	332
Magnesite	79	115

See footnotes at end of table.

Table 3.—Tanzania: Imports of mineral commodities [1]—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS—Continued		
Mica:		
Crude, including splittings and waste ---value--	$34	$7,055
Worked, including agglomerated splittings ---do---	$377	$6,608
Pigments, mineral, natural, crude ---do---	$16,396	$8,691
Salt and brine	4,402	1,176
Sodium and potassium compounds, n.e.s.:		
Caustic soda	6,527	2,352
Sodium carbonate (soda ash)	357	4,417
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	211	17
Worked	20	47
Dolomite, chiefly refractory grade	--	30
Gravel and crushed rock, n.e.s	4	97
Quartz and quartzite	14	2
Sand, excluding metal bearing	54	25
Sulfur:		
Elemental, other than colloidal	22,725	453
Sulfuric acid, oleum	363	83
Talc, steatite, soapstone, pyrophyllite ---value--	$90,089	[3] $73,952
Other nonmetals, n.e.s.:		
Crude:		
Meerschaum, amber, jet	--	25
Other ---value--	$89,727	$24,512
Slag, dross and similar waste, not metal bearing, from iron and steel manufacture	21	357
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	10	5
Coal, all grades, including briquets	150	64
Coke and semicoke	720	521
Gas carbon ---value--	$20,188	--
Petroleum:		
Crude and partly refined ---thousand 42-gallon barrels--	12,039	5,367
Refinery products:		
Gasoline ---do---	132	143
Kerosine ---do---	113	204
Jet fuel ---do---	20	109
Distillate fuel oil ---do---	766	700
Residual fuel oil ---do---	117	52
Lubricants ---do---	185	173
Mineral jelly and wax ---do---	14	5
Other:		
Liquefied petroleum gas ---do---	1	[4]
Nonlubricating oils, n.e.s ---do---	20	4
Pitch and pitch coke ---do---	[4]	1
Bitumen and other residues ---do---	r 22	41
Bituminous mixtures, n.e.s ---do---	r 49	26
Mineral tar and other coal–, petroleum–, or gas–derived crude chemicals	857	486

r Revised.
[1] Includes transfers from Kenya and Uganda.
[2] Excludes quantity valued at $1,166.
[3] Quantity for 1974 not available; quantity for 1975, 337 tons.
[4] Less than ½ unit.

COMMODITY REVIEW

METALS

Gold.—Production of alluvial gold decreased to 10.5 troy ounces because of low rainfall. Prospecting for gold was continued by the State Mining Corp. and the United Nations. The major area under investigation was between Nzega and Kahama on the plateau south of Lake Victoria. Alluvial deposits along the Sira River near Chunya were to be exploited with assistance from the Soviet Union.

Iron Ore.—The Government planned to develop the Chunya iron ore deposits in southwest Tanzania. Teams from China continued a program of study and evaluation on the deposits during 1976. The cost of iron and steel imports during the year was about $33 million, and in an effort to reduce the trade deficit, the Government planned an iron and steel industry based on Chunya iron ore and coal from the Songwe-Kiwera coalfields.

Tin.—The most important metallic export from Tanzania in 1976 was 22 tons of tin concentrate, a 1-ton increase compared with that of 1975. Tin concentrate output for both 1975 and 1976 was low compared with the previous year owing to the lack of rainwater used in tin washing.

Titanium.—Beach Sands Mining Co., Ltd., a joint venture of the Tanzanian and Romanian Governments, operated a pilot plant to process beach sands containing ilmenite and rutile at Siversands near Dar es Salaam. The feasability of mining heavy beach sands at Mtwara and on Pemba Island was under study during 1976.

NONMETALS

Cement.—Production from Tanzania's only cement plant at Wazo Hill near Dar es Salaam continued to decline. Output from the 340,000-ton-per-year plant was 241,000 tons in 1976, a decrease of 10% compared with that of 1975 and 19% below the 1974 level. To meet Tanzania's cement demand, imports increased 40% compared with those of 1975. The Government projected that yearly cement consumption in Tanzania would be 800,000 to 900,000 tons in the early 1980's. To meet the increased demand, the Government began expansion of the Wazo Hill plant to 600,000 tons per year, and was to build a 500,000-ton-per-year cement plant at Tanga on the north coast and a 250,000-ton-per-year plant near Mbeya in the southwest near the Zambian border.

Diamond.—Diamond production decreased 2% in quantity and 15% in value during 1976. The Mwadui mine and adjoining New Alamasi mine in northern Tanzania accounted for all of the 1976 diamond output, with the Mwadui responsible for the bulk of production. The lower diamond output was expected, as evidenced by the mining plan at Mwadui, which called for treating lower grade ores to prolong the life of the mine.

The State Mining Corp. completed a program of trenching and pitting for diamondiferous kimberlites in northern Tanzania but did not report any new deposits.

Gem Stones.—Tanzania's small-scale mines produced a variety of gem-quality minerals including beryl, emerald, garnet, rhodolite, zoisite (tanzanite), and quartz (amethyst). Production of gem stones remained depressed during 1976 owing to marketing difficulties experienced by Tanzania Gemstones Industries, Ltd., the country's only dealer in precious and semiprecious stones. Most of the gem stone production was from mines near Merelaui and Longido in the north between Mt. Kilimanjaro and Lake Natron.

Salt.—Exports of salt from the Uvinza saltworks of Nyanza Salt Mines, Ltd., located east of Kigoma, increased to 9,100 tons in 1976 and in value to $890,000, a 44% increase in value compared with 1975. Salt was produced by solar evaporation of brines from wells and natural springs, and was the second most important Tanzanian mineral export after diamond. The coastal saltworks near Mtwara and Lindi in the extreme south and near Tanga in the north produced salt for domestic consumption. The Lindi saltworks was to be expanded 69 acres at a cost of about $130,000.

Soda Ash.—A team from the Japan International Cooperation Agency conducted a feasibility study on the proposed soda ash project at Lake Natron in northern Tanzania on the Kenya border. The rift valley alkaline shallow lake deposit was estimated to contain over 100 million tons of soda ash. A joint venture of five Japanese companies and the Tanzanian Government planned to construct a 30,000-ton-per-year refining plant on the lake and transport facilities to either the port of Mombassa in Kenya or Tanga in Tanzania. The bulk of the output was to be exported to Japan.[2]

MINERAL FUELS

Coal.—The State Mining Corp., with the assistance of teams from China, continued to investigate the coalfields at Songwe-Kiwera in southwestern Tanzania, near the Malawi border. Prime interest in the coal was its suitability for use in the production of iron and steel.

Petroleum.—Exploration for petroleum continued in Tanzanian waters and on Songo Songo Island, but no important discoveries were made during 1976. The Oil and Natural Gas Commission (ONGC) of India abandoned a wildcat on Songo Songo after a gas blowout at 3,200 feet. ONGC planned to spud a second well on the island in late 1976 or early 1977. Azienda

[2] Japan Chemical Week. Japan-Tanzania Soda Ash Venture to be Studied Again. V. 17, No. 824, Feb. 12, 1976, p. 5.

Generale Italiani Petroli S.p.A. (AGIP) continued exploration activities offshore, and Oceanic Exploration Co. began preliminary seismic surveys in its deepwater concession area off the north coast of Tanzania.

Tanzania imported about 7 million barrels of crude oil to meet most of its 1976 energy demands. The cost of crude petroleum, about $82 million in 1976, continued to strain Tanzania's foreign exchange reserves. The gas deposits on Songo Songo Island and domestic coal resources were studied for possible development to reduce the country's imports of mineral fuels.

The petroleum refinery at Dar es Salaam had an input of about 7.0 million barrels during 1976, an increase of nearly 31% compared with that of 1975.

The Mineral Industry of Thailand

By Gordon L. Kinney [1]

Despite a politically turbulent year, which saw a major cabinet reshuffle, an election campaign marred by considerable violence, a change of prime ministers, and finally the military overthrow of the elected Government, the Thai economy as a whole showed good improvement and largely paralleled the general recovery of the world economy. The year showed very graphically that the economy, which is strongly based on agricultural exports, was almost entirely independent of the nation's politics, which are controlled mainly by the population of Bangkok.

Industrial activity was on the upswing, and the mining industry ended the year showing a significant comeback after a poor showing in 1975 and early 1976. The gross domestic product (GDP) increased 6%, which was about the planned target. Manufacturing, trade, services, transportation, and construction all turned in higher growth rates than in 1975, but growth in agriculture slowed a little from the excellent 1975 crop year. The consumer price index increased by about 4.2%, down from the 5.4% recorded in 1975 and much less than the 24%+ of 1974. The manufacturing sector grew 7.5% during 1976. Agricultural processing plants stepped up activity, processing the large output of the 1975–76 crop year. Overall, the manufacturing sector increased from 17.6% of GDP in 1975 to 18.3% in 1976. The gross national product (GNP) at current prices was estimated at $16.2 billion,[2] up 11% over that of 1975. The GNP at constant 1962 prices was estimated at $8.7 billion, up nearly 6%. Balance of payments showed a nominal $4 million deficit, compared with a $143 million deficit in 1975.

Mineral output declined slightly in 1974 and substantially in 1975. Counter to the general economic upturn in 1976, the nontin-mining sector continued to falter well into the year, mainly because investors and company officials were hesitant about implementing plans owing to political uncertainties. Policy decisions, particularly relating to mining development issues, either went against proposed new projects or were left unsettled during Prime Minister Seni's 5 months in office.

The failure of the Seni Government to effectively guide the country's affairs led to a decision by the Armed Forces to overrule the constitution and dismiss the parliament. Thanin Kraivichien was appointed the new Prime Minister in October. The new Government dealt firmly with labor unrest, banning all strikes and lockouts. After the military takeover, a policy of improving the climate for business and investment was announced, and a new Investment Act was passed to help attract foreign capital.

By yearend 1976 the Thailand Exploration and Mining Co., Ltd. (TEMCO) offshore-tin-mining problem was nearing a solution. The Government approved a management contract with Billiton Thailand Ltd., TEMCO's successor, to work the former TEMCO concessions off Phuket. Negotiations between the new Government and Thai Zinc Ltd. (TZL) for rights to construct a large zinc refinery and to mine a high-grade zinc deposit had progressed satisfactorily and were in the final stages at yearend. Negotiations over the natural gas pipeline project were carried on throughout the year. After the change of Government in

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Thai baht (B) to U.S. dollars at the rate of B20.30 = US$1.00.

October, an agreement between the Ministry of Industry and the Union Oil Company of Thailand was reached on all points except for the gas pricing structure.[3]

Mining in Thailand is based mainly on the tin dredges and many kinds of small-scale, labor-intensive operations. Over 700 mines reportedly were in production at yearend. These provided full-time employment for about 53,000 persons in 39 of Thailand's 71 provinces. Thailand produced 29 kinds of minerals in 1976, headed prominently by tin but also including by-product minerals like tantalite, ilmenite, monazite, and xenotime.

[3] U.S. Embassy, Bangkok, Thailand. Industrial Outlook Report: Minerals. State Department Airgram A-40, Feb. 11, 1977, pp. 1-13.

PRODUCTION

Production of Thailand's three most valuable minerals went up substantially. In 1976, tin production was valued at $151 million, tungsten at $30 million, and antimony at $13 million. Quantitywise, mine output of tin, tungsten, and antimony all increased more than 15%. Fluorite and barite, the fourth- and fifth-ranking minerals, both suffered from lack of demand, with output dropping more than 25% in both cases. Overall mineral production value increased 28%, from $168 million in 1975 to $215 million in 1976, just short of the 1974 record year of $231 million. Prospects for tin look favorable for 1977, owing to the fact that the country's biggest dredge did not contribute to production in 1976. The dredge had been kept in operating condition throughout the year and should be ready to resume operations soon after a new tin contract is signed between the Government and Billiton. Thailand smelts its own tin, and output increased by more than 22% in 1976.

Table 1.—Thailand: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Antimony:			
Ore:			
Gross weight	9,966	7,372	8,637
Metal content	4,236	3,133	3,671
Smelter	376	336	480
Chromium, chromite, gross weight	--	200	--
Columbium and tantalum:			
Ore and concentrate, gross weight:			
Columbite	10	7	--
Tantalite	82	103	6
Copper, mine output, metal content	2	--	--
Iron and steel:			
Iron ore, 55% iron, gross weight	36,303	32,476	25,000
Pig iron	r 16,800	12,626	11,530
Ferroalloys:			
Ferrosilicon	1,059	393	1,159
Ferromanganese	1,770	831	1,509
Steel, primary forms:			
Ingots	220,000	236,224	162,840
Billets	e 150,000	e 240,000	112,276
Semimanufactures (selected):			
Bars	NA	67,756	93,210
Galvanized iron sheets	72,118	83,146	NA
Tinned plates	27,110	20,889	NA
Lead:			
Mine output, metal content	1,543	1,533	904
Metal, unwrought ingot	1,221	944	825
Manganese ore:			
Battery grade and chemical grade, 75% MnO_2	8,846	3,577	3,230
Metallurgical grade, 46% to 50% MnO_2	20,120	20,493	46,865
Chemical grade, over 75% MnO_2	--	844	130
Total	28,966	24,914	50,225
Monazite, gross weight	441	367	--
Tin:			
Mine output, metal content	20,339	16,406	20,452
Smelter:			
Primary	19,827	16,630	20,337
Secondary	9	13	63

See footnotes at end of table.

Table 1.—Thailand: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS—Continued			
Tungsten concentrate:			
Gross weight	r 4,276	3,441	3,976
Metal content	r 2,035	1,637	1,892
Zinc:			
Mine output, metal content	r 32,876	3,220	--
Metal, unwrought ingot	66	66	71
Zirconium, gross weight	2,002	383	55
NONMETALS			
Asbestos	--	--	15
Barite	200,917	258,387	151,343
Cement, hydraulic thousand tons	3,923	3,959	4,422
Clays:			
Ball clay	28,000	--	3,274
Kaolin	60,878	15,782	20,020
Feldspar	6,998	13,025	12,257
Fertilizer materials:			
Crude phosphatic	5,603	5,805	7,250
Manufactured	30,584	153,273	NA
Fluorspar:			
Crude mine production:			
High grade	340,760	174,918	128,529
Low grade	87,931	111,231	71,835
Total	428,691	286,149	200,364
Salable product:			
Acid grade (beneficiated low grade)	54,957	69,519	44,897
Metallurgical grade	340,760	174,918	128,529
Total	395,717	244,437	173,426
Graphite	--	30	30
Gypsum	311,795	255,242	267,822
Salt, rock e thousand tons	160	160	160
Sand, silica	59,640	34,310	24,145
Stone:			
Calcite	50	--	590
Dolomite	400	20	30
Limestone thousand tons	1,836	--	493
Marble	3,645	--	--
Marl (used for cement) thousand tons	227	468	435
Quartz, not further described	10,830	11,330	3,563
Shale	615,200	--	74,504
Sulfur, sulfuric acid	46,940	e 45,000	NA
Talc and related materials:			
Pyrophyllite	1,640	10,300	5,787
Talc	158	347	770
MINERAL FUELS AND RELATED MATERIALS			
Coal, lignite thousand tons	485	462	680
Petroleum:			
Crude thousand 42-gallon barrels	42	e 42	57
Refinery products:			
Gasoline do	8,769	6,004	9,332
Jet fuel do	4,337	4,710	7,673
Kerosine do	1,766	842	976
Distillate fuel oil do	12,305	13,596	15,835
Residual fuel oil do	17,438	17,512	17,748
Other:			
Liquefied petroleum gas do	2,428	2,152	2,590
Naphtha do	2,062	2,367	1,811
Asphalt do	498	589	783
Unspecified do	7,924	5,265	11,370
Refinery fuel and losses do	465	403	389
Total do	57,992	53,440	68,507

e Estimate. p Preliminary. r Revised. NA Not available.

TRADE

Thai exports increased about 33% in 1976, and imports went up over 7%. The higher export earnings reflected larger sales volumes in most cases since prices for many of Thailand's exports were down from the 1975 levels. Tin and rubber were the major exports to show significant price increases. Thailand was second to the

United States in world export of rice in 1976. More rice was sold in the first 9 months of 1976 than in all of 1975. Other agricultural products also did well. Comparing the first 4 months of 1976 with the corresponding period in 1975, sugar exports were up over 80% in value, rubber 77%, and tapioca over 50%. The trade deficit narrowed significantly in 1976. Exports totaled approximately $3.0 billion and imports, $3.6 billion. The roughly $600 million balance of trade deficit was much lower than the $1 billion deficit in 1975. However, the improvement was not entirely favorable since it also reflected a lower demand for capital equipment needed to create new productive capacity.

Thai mining activity is heavily export oriented. Mineral products earned about 10% of the total export income; tin was the most important contributor by far. Eleven other kinds of minerals and metals were exported during the year; namely, antimony, barite, feldspar, fluorspar, gypsum, kaolin, lead, manganese, tantalite, tungsten, and xenotime.

Mineral export earnings totaled approximately $213 million, a 40% increase over the earnings for 1975. The 1976 figure topped by 3% the previous record set in 1974. The value of four of the first five ranking minerals exported registered increases, with only barite showing a nominal decrease because of a lower demand for heavy drilling mud in oil exploration within Southeast Asia.

Exports of tin metal from the Thaisarco tin smelter totaled 19,616 tons in 1976, a 13% increase over the 1975 exports. The United States was the largest purchaser of Thai tin in 1976 with 7,665 tons, followed by Japan with 6,151 tons and the Netherlands with 5,700 tons. Total tin exports were valued at about $144 million, compared with $112 million in 1975. In 1976, tin represented about two-thirds of the total value of mineral exports, and 5% of all exports.

Thailand imported about 7,800,000 kiloliters of crude petroleum in 1976 (a 1-million-kiloliter increase over the 1975 output). Petroleum products imports amounted to 2,300,000 kiloliters in 1976. The import bill for crude oil was $697 million, and that for refined products was $200 million. Petroleum supplied over 80% of the country's energy requirements. Imported crude oil continued to be refined at the 65,000-barrel-per-day Thai Oil Refinery Co., the 65,000-barrel-per-day Summit Industrial Corp. refinery, and the 35,000-barrel-per-day Esso Petroleum Co. Ltd. refinery, all near Bangkok.

Table 2.—Thailand: Exports and reexports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Oxides	(2)	--
Metal including alloys:		
Unwrought	1,692	99
Semimanufactures	126	21
Antimony:		
Ore and concentrate	6,792	4,788
Metal including alloys, unwrought	92	156
Columbium and tantalum, ore and concentrate	40	20
Copper metal including alloys, all forms	r 381	11
Gold metal, unworked, or partly worked--troy ounces	148	--
Iron and steel metal:		
Pig iron, ferroalloys, and similar materials	10,155	57
Steel, primary forms	--	23
Semimanufactures	r 24,057	13,920
Lead:		
Ore and concentrate	170	821
Metal including alloys:		
Unwrought	715	200
Semimanufactures	3	6
Manganese ore and concentrate	18,780	23,626
Silver metal including alloys, all forms--troy ounces	r 6,400	624,592
Tin:		
Metal including alloys, unwrought	20,768	17,290
Slag	6,430	NA
Titanium oxides	39	58
Tungsten ore and concentrate	4,929	3,382

See footnotes at end of table.

Table 2.—Thailand: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS—Continued			
Zinc:			
Ore and concentrate		74,604	19,000
Oxide		141	108
Metal including alloys:			
Scrap		--	220
Unwrought		295	--
Semimanufactures		628	29
Zirconium ore and concentrate		100	50
Other: Ores and concentrates		114,500	1,519
NONMETALS			
Abrasives, grinding and polishing wheels and stones		--	3
Asbestos		1,928	502
Barite		r 67,337	188,584
Cement		r 919,536	729,128
Clays and clay products:			
Crude clays, n.e.s.:			
Fuller's earth, dinas, and chamotte		31	--
Kaolin		2,736	1,003
Products:			
Refractory		418	1,873
Nonrefractory		1,560	809
Diamond, gem, not set or strung	carats	--	238
Feldspar, leucite, nepheline, nepheline syenite		1,355	962
Fertilizer materials:			
Crude and manufactured:			
Potassic		957	142
Other and mixed		12	--
Ammonia, anhydrous		32	9
Fluorspar		305,541	211,699
Gypsum		117,672	92,537
Precious and semiprecious stones, except diamond:			
Natural:			
Precious	thousand carats	4,856	5,863
Semiprecious	kilograms	r 141,126	148,413
Manufactured	do	117	52
Salt		125,956	116,161
Sodium and potassium compounds		411	514
Stone, sand and gravel:			
Dimension stone, all types unspecified		r 610	159
Gravel and crushed rock		73	20
Limestone		45	51
Quartz and quartzite		10,511	3,154
Sulfur, colloidal		10	20
Other slag, dross and similar waste, not metal bearing n.e.s		9,841	4,630
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		1,041	1,151
Carbon black		1	1
Coal briquets		31	1
Petroleum refinery products:			
Gasoline, motor and aviation	thousand 42-gallon barrels	526	260
Kerosine	do	356	353
Jet fuel	do	70	76
Distillate fuel oil	do	220	52
Residual fuel oil	do	7	59
Lubricants	do	14	8
Mineral jelly and waxes	do	(3)	17
Other:			
Liquefied petroleum gas	do	201	14
Unspecified	do	r 11	11
Mineral tar and other coal–, petroleum–, or gas–derived crude chemicals		8	--

r Revised. NA Not available.

[1] Department of Customs, Bangkok, Thailand. Foreign Trade Statistics of Thailand, December 1974 and December 1975.

[2] Revised to none.

[3] Less than ½ unit.

Table 3.—Thailand: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite and concentrate	1,795	6,804
Oxide and hydroxide	11,592	3,764
Metal including alloys:		
Scrap	457	97
Unwrought	23,784	18,434
Semimanufactures	6,344	4,269
Antimony:		
Ore and concentrate	132	21
Metal including alloys, all forms	--	(1)
Arsenic trioxide, pentoxide, acids	124	12
Cadmium metal including alloys, all forms	1	1
Chromium, oxide and hydroxide	302	187
Cobalt:		
Oxide and hydroxide	16	2
Metal including alloys, all forms	3	(1)
Copper:		
Matte	127	72
Copper sulfate	266	69
Metal including alloys:		
Scrap	712	631
Unwrought:		
Blister copper and other unrefined copper	267	458
Refined, unalloyed	277	2,202
Master alloys	1	7
Semimanufactures	6,604	6,635
Gold metal, unworked or partly worked ---troy ounces--	781	2,244
Iron and steel:		
Metal:		
Scrap	255,920	257,187
Pig iron, ferroalloys, similar materials	7,071	6,232
Sponge iron, powder, shot	260	147
Steel ingots and other primary forms	18,814	16,070
Semimanufactures	654,982	552,785
Lead:		
Oxide	r 522	458
Metal including alloys:		
Scrap	45	441
Unwrought	5,396	7,778
Semimanufactures	288	119
Magnesium:		
Oxide	25	43
Metal including alloys:		
Scrap	(1)	--
Unwrought	6	1
Semimanufactures	16	(1)
Manganese:		
Ore and concentrate	8,292	185
Oxides	383	425
Mercury ---76-pound flasks--	r 253	61
Molybdenum metal including alloys, all forms	(1)	(1)
Nickel:		
Matte, speiss, similar materials	7	3
Metal including alloys:		
Scrap	1	(1)
Unwrought	90	30
Semimanufactures	495	216
Platinum-group metals including alloys, all forms ---troy ounces--	32	1,318
Silver metal including alloys ---do---	70,732	68,031
Tin:		
Oxides	(1)	(1)
Unwrought	1	3
Semimanufactures	17	20
Titanium:		
Ore and concentrate	591	--
Oxide	2,248	1,446
Tungsten metal including alloys, all forms	2	4
Zinc:		
Oxide	685	209
Metal including alloys:		
Scrap	162	198
Powder and dust	28	1
Unwrought	23,286	18,501
Semimanufactures	r 1,328	84
Other:		
Ore and concentrate of base metals, n.e.s	r 5,981	7,751
Metals including alloys, all forms:		
Alkali, alkaline earth, rare-earth metals	(1)	(1)
Pyrophoric alloys	56	19
Base metals including alloys, all forms, n.e.s	6	16

See footnotes at end of table.

Table 3.—Thailand: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	1,888	2,296
Dust and powder of precious and semiprecious stones ——kilograms	2	3
Grinding and polishing wheels and stones	1,052	1,083
Asbestos	41,802	43,024
Barite and witherite	14	4
Bromine:		
Elemental ——kilograms	1	2
Compounds, n.e.s ——do	51,633	43,338
Cement	r 516	358
Chalk	509	551
Clays and clay products:		
Crude clays, n.e.s.:		
Fuller's earth, dinas, chamotte	6,360	3,666
Kaolin	5,055	2,546
Products:		
Refractory (including nonclay brick)	r 8,806	10,299
Nonrefractory	r 2,378	2,033
Diamond:		
Gem, not set or strung ——carats	4,731	3,068
Industrial ——do	19,351	26,901
Diatomite and other infusorial earth	11	5
Feldspar, leucite, nepheline, nepheline syenite	r 1,821	841
Fertilizer materials:		
Crude and manufactured:		
Nitrogenous	51,614	86,369
Phosphatic	6,178	900
Potassic	8,259	25,980
Other including mixed	272,535	312,083
Ammonia, anhydrous	226	234
Fluorspar	5	13
Graphite, natural	1,234	1,217
Gypsum, anhydrite, plasters	401	292
Iodine	3	1
Lime	140	130
Magnesite	1,469	3,998
Mica	104	46
Pigments, mineral, including processed iron oxides	r 1,984	741
Precious and semiprecious stones, except diamond:		
Natural ——kilograms	717,244	209,730
Manufactured ——do	4,093	3,293
Salt	196	149
Sodium and potassium compounds	7,633	2,323
Stone, sand and gravel:		
Dimension stone:		
Crude:		
Calcareous (marble)	240	--
Slate	40	20
Other	705	404
Worked:		
Calcareous (marble)	2,400	1,226
Slate	120	93
Paving and flagstone	3	3
Other	227	211
Dolomite, chiefly refractory grade	11	29
Gravel and crushed rock	688	755
Limestone (except dimension)	45	--
Quartz and quartzite	402	279
Sand, excluding metal bearing	103	708
Sulfur:		
Elemental:		
Other than colloidal	33,244	38,935
Colloidal	351	145
Sulfur dioxide	(1)	1
Sulfuric acid	r 44	117
Talc and steatite	8,421	3,619
Other nonmetals n.e.s.:		
Crude	4	1
Slag, dross, and similar waste, not metal bearing	3,342	1,864
Oxides and hydroxides of barium, magnesium, and strontium	r 28	3,642

See footnotes at end of table.

Table 3.—Thailand: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity		1974	1975
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		3	5
Carbon black		12,825	8,234
Coal, all grades, including briquets		2,745	4,566
Coke and semicoke		31,331	29,674
Petroleum:			
Crude and partly refined:			
Crude	thousand 42-gallon barrels	27,668	42,815
Partly refined	do	13,992	9,786
Refinery products:[2]			
Gasoline:			
Aviation	do	134	179
Motor	do	154	386
Kerosine	do	44	43
Jet fuel	do	(1)	127
Distillate fuel oil	do	r 6,451	7,485
Lubricants	do	r 640	404
Other:			
Liquefied petroleum gas	do	r 11	23
Mineral jelly and wax	do	45	53
Nonlubricating oils, n.e.s	do	2,446	320
Bitumen and others	do	2	8
Bituminous mixtures, n.e.s	do	3	1
Pitch, pitch coke, petroleum coke	do	r 77	129
Unspecified	do	r 113	15
Total	do	r 10,120	9,173
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		1,145	439

r Revised.
1 Less than ½ unit.
2 Includes bunkers.

COMMODITY REVIEW

METALS

Antimony.—A new mine was commissioned in 1976 at Phahad in Phrae Province, the country's first modern mechanized underground antimony operation. Phluang Thong Thai Co., an affiliate of the Hochschild Group, is the owner. Annual output was planned at 1,000 tons of mine antimony.[4]

The Hibino Metal Industrial Corp. Ltd., of Japan reported it would begin operating a new property near Chiang Mai. Planned production would be 100 tons per month of 60% concentrate. Technical problems at Hibino's present 150-ton-per-month Banpin workings (also near Chiang Mai) were making mining at this location increasingly difficult.

Production of antimony, Thailand's third most important mineral, increased 17% to 8,637 tons of 60% concentrate. About 480 tons of refined metal were also produced. Exports for 1976 were reported at 5,861 tons of concentrate worth $4.6 million, most of which went to Western Europe. Two hundred fifty-three tons of refined metal was also exported.

Iron and Steel.—Iron ore production remained at very low levels. The iron ore was consumed locally by two small blast furnaces. Production of steel from imported scrap dropped 32% to 370,000 tons.

A 150,000-ton-per-year sponge iron plant using lignite as the reductant was being planned for Thailand. The project was reportedly being promoted by the G. S. Steel Co., with the New Zealand Steel Ltd. scheduled to provide technical know-how. In light of the availability of iron ore reserves within Thailand, an early start on construction of the proposed plant appears unlikely.

The Ministry of Industry was planning to explore for additional iron ore in 11 provinces in the central and eastern parts of the country. The latest estimate on Thailand's iron ore reserves is only 40 million tons.

Manganese.—One of the bright spots in the mining sector was manganese. Total mine output value came to $2.2 million for some 50,000 tons of product, or roughly

[4] Mining Journal (London). Mining Annual Review 1977. June 1977, p. 411.

twice the 1975 figures. Most of Thailand's manganese ore has been exported. Japan and Taiwan were the main customers in 1976, using Thai manganese in iron and steel smelting and in the making of dry cell batteries. During 1976, trial shipments also went to the United Kingdom, West Germany, the Netherlands, and Sweden. Domestic consumption was 4,000 to 5,000 tons of battery-grade ore, by several dry cell companies.

There were 9 to 11 operating mines in 1976, employing altogether 500 to 600 workers. The Sahachart Mining Co. owns Thailand's largest manganese mine and mill, located at Mae Tang in Chiang Mai Province. During the year, the mill was expanded from 200 to 1,000 tons of ore per day.

Tantalum-Columbium.—Six tons of tantalite and seven tons of tantalum-columbium concentrate were reportedly produced in 1976. This does not, however, include the rather considerable tonnage of tantalum–columbium–rich tin slag produced by the Thaisarco tin smelter in Phuket. Exports of the slag were known to have been made during the year, mainly to the United States, but no values or tonnages were reported. The Ta_2O_5 content of the Thaisarco slags that were exported was about 12%, and the Cb_2O_5 content was about 10%. This slag is one of the major sources of tantalum-columbium in the world, with a real value running into several million dollars annually.

Tin.—Tin again was the dominant factor in the mineral economy of Thailand in 1976. Output of tin concentrates increased sharply to nearly 28,000 tons, and output of smelter tin increased to 20,390 tons. Thailand ranked fourth among market economy countries as a producer of tin. The bulk of the production came from gravel-pump operations and lowland dredging of placer deposits. About 15% came from small lode and open pit mines in the mountainous areas, and more than 25% came from offshore marine dredging operations. The bucket line dredges *Aokam No. 2* and *Aokam No. 3* and the *Sea Dredge* operated only during favorable parts of the year. The Aokam Tin Bhd., Tongkah Harbour Tin Dredging Bhd., and Southern Kinta Consolidated Ltd. dredges encountered labor troubles in January which were not settled until April. Lease renewals were not agreed on between Southern Kinta and the Government, and this prevented the company from operating its dredge the remainder of 1976. The big *TEMCO II* suction dredge was not operated during the year.

As a result of cancellation of TEMCO's offshore mining leases in 1975, Billiton bought out all of TEMCO's holdings and equipment and began negotiations with the Government's newly formed Offshore Mining Organization (OMO). OMO wanted to lease the valuable offshore mining rights near Phuket on the west coast to Billiton on a contractual basis. Negotiations remained stalled through most of the year, but, after the change in Government in October 1976, the new administration made a more concerted effort to reach a mutually agreeable settlement.

In December, OMO and Billiton were nearing a settlement and OMO had agreed to a sliding-scale revenue-sharing arrangement. Billiton had no claim to OMO's concession areas, but remuneration from working them would be derived from the revenue of the mined tin. Details of the agreement were reported as follows: 68.75% of the profit of the first 1,300 tons of tin goes to Billiton, and the remaining 31.25% goes to OMO; the split is 60–40 for the next 200 tons, and for the following 200 tons, it is 50–50; for any production over 1,700 tons per year, the split is 60–40 in favor of OMO.[5] The new Thai Cabinet had approved the conditions on December 8 and were awaiting Billiton's signature at yearend. The period of the agreement was to be for 5 years with option of renewal for 2 years longer. The settlement was viewed as a direct encouragement to foreign investment and will probably be used as a model for other mineral contract negotiations.

After the TEMCO operation ceased in 1975, a fleet of small illegal tin-mining boats operated in the area east of Phuket. These ranged from small boats with individual divers using primitive air hoses and wicker baskets, to converted fishing boats using diesel-powered suction hoses. The boats had onboard sluices which gave a product averaging 30% tin. During the year, as many as 5,000 boats operated in the shallower waters. More than 38,000

[5] The Wall Street Journal. V. 188, No. 114, Dec. 10, 1976, p. 10.

persons were then employed in the dredging and beneficiation of the ore, both onshore and offshore. The boats were winning a great deal of high-grade ore, and most of this was smuggled out of the country without the Government receiving any revenue. To get the problem under control, the Government finally allowed the Phang Nga Province administration to license and legalize these boats to use a small area of the former TEMCO leases. The boats were restricted to 20 meters in length, a maximum of 150 horsepower, and suction hose no more than 10 centimeters in diameter. All of the concentrates must be sold to the Government, and boat owners were to pay a royalty of 80 bahts per picul (about 3 cents per pound).[6]

The importance of these small suction boat operations can be seen from the fact that over 6,000 tons of tin concentrate was reportedly produced during 1976, or nearly 23% of the national total.[7]

Cooperation between Thai and Malaysian authorities during 1976 and the above-mentioned licensing of the small mining boats have significantly reduced the incidence of tin smuggling from western Thailand's waters. Thus, the recorded increase in Thailand's 1976 tin production was actually due more to the reduction in smuggling and the first-time reporting of the suction boat operations than to any really significant increase in actual tin production.

It was reported late in the year that Charter Consolidated Ltd., a British mining company, in partnership with Bethlehem Steel Corp. and Aluminum Co. of America, was interested in offshore dredging activities in Thailand. Charter prospected in about 20 meters of water 1 to 2 kilometers off Phuket Island and confirmed a large volume of ore judged marginal at 1976 prices. Charter has reportedly spent $8 million on the surveying and on the design of a new dredge that can be used 10 months of the year instead of the more standard 6-month period. The project may run into difficulty on environmental grounds because a crucial part of the ore reserves are in Patong Bay off Phuket Island. Patong is a prime tourist resort, and land developers plan a considerable expansion in the area.

Sierra Mining Co. was considering setting up a new tin-dredging operation on the Tha Khwai River in Nakhon Si Thammarat Province in southern Thailand. Sierra owns an old dredge that could be brought from northern California.

World tin prices showed a considerable improvement after a poor year in 1975. Average monthly prices, which dropped in all but 2 months in 1975, climbed steadily through all but 2 months of 1976. The average Metals Week composite price in the United States during 1976 was $3.80, and at yearend the price was $4.40 per pound.

The Thaisarco plant at Phuket is Thailand's only modern tin smelter. It continued to smelt virtually all of the country's tin.

Tungsten.—Production of tungsten concentrate, Thailand's second most valuable mineral, increased from 3,441 tons in 1975 to 3,976 tons in 1976, reversing the downward trend of the last few years. Value of the concentrate produced was nearly $30 million. While production increased 16% the value of the concentrate increased nearly 38% because of increased world prices. Thailand's tungsten production ranked third in the world among market economy nations. Exports of tungsten were in the form of scheelite and wolframite concentrate. In 1976, 624 tons of scheelite was shipped for $4.4 million, and 3,300 tons of wolframite was exported for $20.7 million.

The Sichon tin–tungsten lode-mining project of Faber Merlin began trial operation of its mill on February 15, 1976. Full operation was scheduled for September, at 3,000 tons of ore per month. Yield was expected to be 500 piculs of tin (30 tons) and 60 piculs of tungsten (4 tons) per month.

At yearend 1976, 16 wolframite and scheelite lode mines were in operation, together with 175 tin–tungsten placers. About 40% of Thailand's tungsten is produced in conjunction with tin. The Khao Soon mines in Nakhon Si Thammarat Province accounted for nearly half of the total tungsten output. Illegal mining and smuggling by thousands of freelance miners in Khao Soon had made for a politically unstable environment during the last few years, adversely affecting production. In June 1976, however, the Government sent

[6] World Mining. V. 30, No. 4, April 1977, pp. 43–45.

[7] Pages 409–413 of work cited in footnote 4.

a large security force into the area to restore and maintain order, and this no doubt was instrumental in increasing production.

Zinc.—All mining and shipment of zinc ores stopped during 1976 pending the outcome of protracted negotiations between TZL and the Thai Government. TZL planned to construct a 60,000-ton-per-year electrolytic zinc refinery at the provincial capital of Tak, about 370 kilometers north-northwest of Bangkok. The refinery would process the rich zinc silicate ores of Mae Sot, 70 kilometers west of Tak. Ore reserves are relatively small (4 million tons), but the grade averages 25% zinc. TZL, a subsidiary of New Jersey Zinc Co., was reportedly nearing a final agreement with the new Thai Government at yearend. Most major bargaining points had been agreed to by both parties, and only the profit-sharing arrangements were left to be worked out. Thai officials want assurances that the best interests of the country are met in the exploitation of Thailand's nonrenewable natural resources. While being cautious with the financial aspects of the contract, the Government was nevertheless eager to complete the arrangements. It was hoped that the project would show other potential foreign investors that the new Government was actively trying to fundamentally improve the private investment climate in Thailand.

It was reported that Hwashin Industrial Corporation of the Republic of Korea had obtained the primary contract for the construction of the $40 million refinery. The total project was to cost about $95 million and would represent the largest foreign investment in Thailand.

Other Metals.—The Thai board of investment reportedly approved the Bangkok-based Euro-Thai Co.'s planned 900-ton-per-year copper and 670-ton-per-year tin mine at Tambol Tham Thalu, in the Amphoe Bannang Sata area of Yala Province.[8]

Canadian-Siam Resources Co. began mill testing of ore at its Lusah lead-zinc-silver-tin mine.

NONMETALS

Barite.—Production of barite, the fifth most important Thai mineral in value, dropped more than 40%, to about 150,000 tons, valued at over $4 million. The decline was attributed not to a lack of ore or to mining problems, but to a reduction in foreign demand due to a severe cutback of petroleum exploration drilling in Southeast Asia. The international oil industry is the main consumer of heavy barite drilling mud.

In June 1976, a new 50,000-ton-per-year barite milling plant was opened in Tha Sala, Nakhon Si Thammarat Province, by the Thailand Barite Co., an affiliate of Dresser Industries. Output of the plant, however, was at a minimum level pending an increase in demand for drilling mud.

Endeavour Oil N.L. explored a barite find at its Thung Wa property. Diamond drilling indicated additional possible reserves, and further exploration work was planned for the site.

Cement.—The cement industry had a good year in 1976, reflecting expanded activity in Government and private housing construction and in the construction of new commercial buildings. Domestic consumption was up 24% for the year, compared with the 6% increase recorded in 1975. Another factor that stimulated production was the price increases sanctioned by the Government in March and July. These increases allowed an equitable profit margin for the privately owned cement operators, who had reportedly been operating at a loss in the face of rising production costs.

Total production capacity increased to 5.1 million tons with the completion of the Kaeng Koi plant in Saraburi Province in late 1975. The production for 1976 of nearly 4.5 million tons was an increase of 12.8% over 1975.[9] Thai cement producers anticipated that domestic demand will increase about 11% per year over the next 5 years.

Cement exports totaled 604,000 tons in 1976, a decline of 17% from that of 1975. However, to encourage exports, the Government removed its export license requirements in November, thereby permitting long-term contracts to be entered with foreign buyers. Increased competition from Japan, Republic of Korea and Taiwan had cut into Thailand's export sales.

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[8] Tin International (London). V. 49, No. 11, November 1976, p. 396.

[9] U.S. Embassy, Bangkok, Thailand. Cement Production and Sales in 1976. State Department Airgram A-46, Feb. 18, 1977, 3 pp.

Fluorspar.—Output of fluorspar, declining since 1973, dropped sharply again in 1976. Production of metallurgical-grade ore was down 27% to 128,000 tons worth $5.7 million, and low-grade ore production 35% to 72,000 tons worth $1.6 million. Export tonnages fared better, with over 200,000 tons of metallurgical-grade fluorspar valued at $8.4 million and over 90,000 tons of acid-grade fluorspar valued at $5.3 million shipped in 1976. Unfavorable world prices and demand forced many fluorspar mines to cease operations. By December 1976 only 38 mines were at work compared with 66 during some months of 1974. Thailand was and still is one of the world's major producers of fluorspar, although output tonnage and value have been cut more than half compared with peak levels in the past.

Gypsum.—Gypsum production rose a modest 5% for the year, but exports continued to decline. In 1976, exports were only 62,000 tons, a decrease of 33% from the 1975 level. Malaysia, Taiwan, and Indonesia have been the major recipients. Increased activity in the construction industry accounted for improved domestic consumption, which increased 23% to 164,000 tons in 1976. The value of production for gypsum was $3.4 million, which ranked it sixth in minerals produced in Thailand.

Silica Sand.—The Thai Glass Industries Ltd. in Bangkok completed a $6.7 million expansion program in October. Construction of a 160-ton-per-day glass production furnace, the largest in Southeast Asia, was the major expense. Technical experts from Australian Consolidated Industries Ltd. utilized latest technology in the design and construction of the plant. Designed capacity is 350 tons per day of blown and pressed glass containers, for consumption within Thailand. Silica sand production dropped 30% in 1976 but should pick up in 1977 with the startup of the new furnace line.

Other Nonmetals.—The Department of Mineral Resources continued its evaluation of the Cretaceous evaporite deposits of northeastern Thailand. Large reserves of rock salt, gypsum, and potash (carnallite, $KMgCl_3 \cdot 6H_2O$; and sylvite, KCl) have been known for some time. It was announced that the Asian Development Bank would finance a detailed feasibility study of the deposits. The main project presently envisioned is a 360,000-ton-per-year soda ash plant based on the very pure rock salt reserves. A rock salt mine with a 1.6-million-ton-per-year capacity would support the plant. The $160 million project would be a cooperative venture of the Association of Southeast Asian Nations. Soda ash (Na_2CO_3) is a basic industrial chemical used in glass manufacturing, ceramics, soap and detergents, pulp and paper, textiles, and metal and petroleum refining.

MINERAL FUELS

Coal.—*Lignite.*—Despite the highly publicized natural gas discoveries, lignite remained the only significant fuel produced in Thailand during 1976. Production increased 47% to a record 680,000 tons. The two most important mines were at Krabi in the south and Mae Moh in the north. The Department of Mineral Resources was evaluating other lignite occurrences throughout the country.

The main consumer of lignite is the Electricity Generating Authority of Thailand, which operates lignite-fired powerplants near the two mines and at Bangkok. Growing amounts of lignite also are being used as fuel in industrial applications. The lignite consumed in Thailand represented 2.3% of the total energy used in 1976.

Petroleum and Natural Gas.—Continued exploration in the Gulf of Thailand confirmed considerable reserves of natural gas and condensate but only small showings of oil. In June 1976 the Union Oil Co. of Thailand consortium made the first strike in exploration Block 10 in 73 meters of water. The well was reported testing at 538,000 cubic meters per day (19 million cubic feet) and 700 barrels per day of condensate. It was the 32d exploration hole drilled in the Gulf and the 9th to show encouraging amounts of natural gas, gas condensate, or in two cases a small amount of light crude oil.

In October another strike was reported in Block 15 by the Texas/Tenneco group. The well produced gas and condensate from 12 zones at a depth of 2,400 meters. Some zones showed considerable carbon dioxide content, but further test results were not available.

The Thai Government awarded supplemental petroleum concessions to British

Petroleum Company Ltd., and Tenneco Thailand Inc., and four new participants.[10] The new companies were Texas Pacific Thailand Inc., Canadian Superior Oil Company Limited, and Highland Thailand Ltd. The concessions were in parts of Blocks 1 through 4 and 14 through 17 in the Gulf of Thailand.

Drilling off the west coast of Thailand continued during the year, and Esso Exploration Inc.'s *Discoverer 534* completed its fifth hole. Each of the last four holes set world records for commercial exploration in deep water. The last hole was drilled in 1,055 meters of water. *Discoverer 534*, one of the largest and most sophisticated drilling ships afloat, uses an anchored mooring system attached to a stationary mooring collar under the center of the ship. The entire ship rotates freely around the collar and maintains proper heading in rough weather by computer-controlled dynamic positioning.

Unfortunately, no commercial quantities of oil or gas were reported in the 11 wells drilled by Esso and Union in their respective W–9 and W–8 concession blocks. At yearend, Esso was still evaluating the results of its drilling program. Any discovery made in these deepwater blocks would have to be very large in order to justify the cost of developing an oilfield in water over a kilometer deep.

Planning continued for the exploitation of the natural gas deposits in the Gulf of Thailand. Continued exploration drilling during the year indicated more reserves than originally believed. Blocks 10, 12, 13, and 15 were now reported to contain an aggregate total of 110 billion cubic meters of recoverable reserves.[11]

Negotiations between the Government and Union Oil Co. were conducted again in 1976, but no contract had been agreed to at yearend. The key points of contention were the pricing structure that would be allowed by the Department of Mineral Resources and the ultimate natural gas pipeline ownership. To break the deadlock, the Government hired a British firm to advise them in determining an equitable price and a French firm to determine the best size and route for the pipeline to Bangkok.

The Government originally wanted Union to take full responsibility for the pipeline construction. However, it was pointed out that the financing of the project would be easier and at lower interest rates if the Government owned the pipeline. Also, if owned by the Government, the procurement of the overland section of right-of-way would be easier, and the line could be used as a common carrier to transport gas from each of the private company's fields. The Government finally agreed to be owner and operator of the line. Pricing of the gas had not been settled at yearend, and negotiations could continue into mid-1977 before an accord is reached. The Government felt the delivered price of gas at Bangkok should be substantially below that of an equivalent amount of imported oil. Union wanted a wellhead price of around $1.60 per thousand cubic feet in order to justify the huge cost of developing the offshore gas and to provide a fair return on its investment. At yearend estimated cost for the project was reported to have risen to $250 million for laying the pipeline and to an equal amount for developing the gasfields.

The Defense Energy Department reportedly was to launch a survey for additional onshore oil production from Fang District in Chiang Mai Province. A Romanian oil company may assist in the work. Romania was already helping the Thai oil industry with a training program for Defense Energy Department officials in Romania. The very small Fang oilfield is currently the only active oil producer in the country; its total reserves are less than 1 million barrels.

A proposal for the construction of a lubricating oil plant was made by the Royal Dutch/Shell Group of Companies. Prospects for the plant being approved were considered better since the October change in Government. Shell and the previous administration were deadlocked on the financial arrangements and the ownership details. The plant would be built at the Thai oil refinery in Sriracha, about 120 kilometers from Bangkok. Because of the sophisticated equipment and technology needed for this modern plant, it would cost about $114 million, about $15 million more than the original 65,000-barrel-per-day refinery. Capacity of the lubricating oil plant, which would operate as part of

[10] Petroleum Times (London). V. 80, No. 2033, August 6, 1976, p. 4.
[11] Business Review. The Gas in the Gulf. V. 5, No. 2, March 1977, pp. 78–83.

the flowsheet of the refinery, was planned at 180,000 tons per year.

Consumption of refined products in 1976 was down about 5%; the biggest declines were in gasoline and diesel oil. Fuel oil, kerosine, liquefied petroleum gas and jet fuel showed small increases. Fuel oil consumption was held down by the nearly 50% increase in domestic lignite production, much of which was used to replace fuel oil in boiler furnace uses.

The Mineral Industry of Tunisia

By E. Shekarchi [1]

The Tunisian economy continued to display strength and versatility in 1976. Its excellent performance during the fourth development plan (1973–76) was attributed in part to a revival of private investment activity throughout the economy. The economic policy of the Government encouraged the private sector to take an active role in development. The Government, meanwhile, retained the prerogative to guide and direct the path of development, to invest actively in crucial economic sectors that required large capital outlays, and to finance infrastructure. In addition, Tunisian legislation granted tax and other advantages to domestic and foreign investors in labor-intensive projects.

Viewing the economy on a sectoral basis, the industrial sector, which overall advanced about 4%, was heavily influenced by a weak mining and energy sector. Although phosphate shipments recovered in 1976, prices were down, from $56 per ton in 1974 to $32 [2] per ton in 1976, and production was cut back to reduce excess stocks accumulated in 1975. Petroleum output was down as onshore production at the El Borma Field continued to fall and the results of new exploration were not yet realized. Resolution of a border dispute with Libya over a highly promising offshore operation was still pending.

The preliminary gross domestic product (GDP) for 1976, based on current prices, was estimated at $4.41 billion, a 1.6% increase over the 1975 GDP, also calculated using 1976 prices. The contribution of the mineral industry, including both minerals energy, was 15% in 1976.

Details of the fifth development plan (1977–80) were released in the latter part of 1976. Investment for the fifth plan was targeted at $9.6 billion. Economic planners projected a job for each new entrant to the labor force by 1981, or a total of 233,000 new nonfarm jobs over the 5-year period. Projects and plans that were to affect the mineral industry follow:

A major offshore natural gasfield, Miskar, discovery of which was announced in early 1975, was to be developed by the Tunisian Government as major shareholder and the French company Elf-Aquitaine as a partner. Also, to reduce Tunisian imports of refined petroleum products, the Government plan called for immediate major expansion of the Bizerte refinery. Extensive expansion programs in phosphate mining, road construction, land reclamation, dam construction, and construction of a nitrogenous-phosphatic fertilizer plant were foreseen in the fifth plan.

In the field of construction and engineering services for cement and electrical power, the new plan proposed two additional cement plants by yearend 1980; Tunisia imported more than half of its cement needs in 1976.

The fifth plan included proposals for railway modernization including new track, rolling stock, signal systems, a new terminal for Tunis, and linkup with the Trans-Maghreb railroads.

The agreement concluded between Tunisia and the European Economic Community (EEC) in 1969 was broadened further in 1976. Under the new provisions, member States of the EEC and Tunisia granted to workers active in each other's territories, the same rights as those enjoyed by their own citizens as far as working conditions, wages, and social security were concerned.

[1] Supervisory physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Tunisian dinars (TD) to U.S. dollars at the rate of TD1 = US$2.32.

Also, by the terms of the new agreement, the EEC proposed to invest in the promotion of Tunisian production and infrastructure in the areas of industry, agriculture, trade, technology, science, and environmental protection. The EEC agreed to make available to Tunisia a fund totaling $100 million, of which about $18 million was a gift and the remainder a loan. This cooperation was aimed primarily at intensifying trade between the partners and at providing Tunisian products with easier access to the Common Market.

PRODUCTION AND TRADE

Available data on mineral production are given in table 1. Data on exports and imports are given in tables 2 and 3, respectively.

Table 1.—Tunisia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Iron and steel:			
Iron ore and concentrate, gross weight ---thousand tons	818	616	494
Pig iron ---do	[r] 12	6	9
Steel, crude ---do	[r] 132	129	103
Lead:			
Mine output, metal content	12,504	10,916	16,716
Metal, primary, unalloyed [2 3]	[r] 20,172	23,396	23,476
Mercury metal, primary ---76-pound flasks	85	[e] 80	[e] 80
Silver metal, primary ---thousand troy ounces	136	289	251
Zinc, mine output, metal content	6,240	6,458	7,345
NONMETALS			
Barite	17,366	14,900	23,400
Cement, hydraulic ---thousand tons	540	616	478
Clays, construction [e] ---do	160	255	195
Fertilizer materials:			
Crude, natural, phosphate rock ---do	3,823	3,512	3,301
Manufactured:			
Hyperphosphate ---do	51	9	90
Superphosphate ---do	30	51	49
Triple superphosphate ---do	400	304	577
Fluorspar, chemical-grade	[r] 28,000	33,917	34,800
Gypsum	--	--	38,800
Lime, hydraulic ---thousand tons	146	283	318
Salt, marine ---do	[r] 296	420	288
MINERAL FUELS AND RELATED MATERIALS			
Gas:			
Natural:			
Gross production ---million cubic feet	7,600	19,400	15,891
Marketed production ---do	7,098	7,497	7,554
Manufactured ---do	670	[e] 690	[e] 700
Petroleum:			
Crude oil ---thousand 42-gallon barrels	31,841	35,532	28,600
Refinery products:			
Gasoline ---do	[r] 1,042	1,118	1,104
Kerosine ---do	707	650	833
Distillate fuel oil ---do	[r] 2,243	2,541	2,415
Residual fuel oil ---do	3,115	3,287	3,241
Other ---do	[r] 682	748	649
Refinery fuel and losses ---do	[r] 1,076	460	790
Total ---do	[r] 8,865	8,804	9,032

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the commodities listed, a variety of crude construction materials (common clays, sand, gravel, and stone) are also produced, but output is not reported, and available information is inadequate to make reliable estimates of output levels.

[2] Pig lead only (excludes lead content of antimonial lead).

[3] From domestic and imported ores.

Table 2.—Tunisia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	r 188	25	All to France.
Copper metal including alloys, all forms	r 860	162	Belgium-Luxembourg 119; France 32.
Iron and steel:			
Ore and concentrate	526,354	295,611	West Germany 231,000; Czechoslovakia 31,000; Belgium-Luxembourg 30,435.
Metal:			
Scrap	1,974	3,571	Yugoslavia 2,374; Switzerland 650; Spain 542.
Pig iron and ferroalloys	7,116	751	All to Italy.
Steel, primary forms	40,046	2,289	Mainly to Italy.
Semimanufactures	44,557	4,586	Mainly to Algeria.
Lead metal including alloys, all forms	r 48,118	20,596	Greece 7,705; Algeria 3,600.
Mercury ---76-pound flasks	561	--	
Silver ---troy ounces	r 67,548	83,592	All to France.
Zinc:			
Ore and concentrate	10,600	8,195	Algeria 6,585; Bulgaria 1,610.
Metal including alloys	29	53	All to France.
NONMETALS			
Barite and witherite	6,050	5,000	All to Algeria.
Cement	r (1)	1	All to Libya.
Clays and clay products (including all refractory brick):			
Crude clays	29	137	Algeria 77; Libya 57.
Products, nonrefractory	r 62,016	25,616	Mainly to Libya.
Feldspar and fluorspar	25,566	12,050	Italy 9,450; United States 2,600.
Fertilizer materials, phosphatic:			
Natural ---thousand tons	2,651	2,098	Turkey 399; Poland 341; Greece 332; France 318.
Manufactured ---do	r 631	238	France 48; Italy 45; Indonesia 41.
Lime	--	1	All to Libya.
Salt and brine	259,253	197,710	Iceland 48,923; Norway 41,395; Yugoslavia 30,800.
Sand	2	5	Italy 4; Libya 1.
Sulfur, sulfuric acid, oleum	5,379	11,193	Turkey 8,129; Romania 2,733.
Talc	7	--	
MINERAL FUELS AND RELATED MATERIALS			
Petroleum:			
Crude ---thousand 42-gallon barrels	28,730	36,692	Italy 9,177; Greece 8,776; United States 7,038; France 6,101.
Refinery products:			
Gasoline ---do	1	2	All to bunkers.
Kerosine ---do	r 477	881	Bunkers 510; Italy 371.
Distillate fuel oil ---do	49	31	Mainly to bunkers.
Residual fuel oil ---do	r 65	186	United States 90; Italy 73.
Lubricants ---do	6	2	Mainly to bunkers.
Other ---do	328	2	All to bunkers.
Total ---do	r 926	1,104	

r Revised.
1 Less than ½ unit.

Table 3.—Tunisia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum metal including alloys:			
Unwrought	1	3	All from France.
Semimanufactures	1,385	1,606	France 401; Italy 323; Belgium-Luxembourg 166.
Chromium oxide and hydroxide	3	11	West Germany 8; France 2; Netherlands 1.
Copper metal including alloys, all forms	2,102	1,859	France 1,049; Belgium-Luxembourg 310; Italy 302.
Gold metal, unworked or partly worked, thousand troy ounces	20	32	Switzerland 28; Italy 3.
Iron and steel metal:			
Scrap	480	662	Algeria 300; France 196; Italy 81.
Pig iron and ferroalloys	711	990	France 441; Japan 300.
Sponge iron, powder, shot	87	72	France 55; West Germany 10.
Steel, primary forms	r 7,218	6,731	France 4,046; Italy 1,402; Belgium-Luxembourg 777.
Semimanufactures	r 101,963	123,278	France 60,740; Italy 26,954; Belgium-Luxembourg 14,038; Japan 12,382.
Lead:			
Ore and concentrate	26,715	24,089	Morocco 11,549; Algeria 5,340; United Kingdom 2,832.
Oxides	54	117	France 37; West Germany 35; United Kingdom 25.
Metal including alloys, all forms	49	20	France 13; United Kingdom 3; Switzerland 2.
Magnesium metal including alloys, all forms	r 2	2	Mainly from France.
Mercury, 76-pound flasks	3	440	People's Republic of China 300; France 85; Netherlands 44.
Nickel metal including alloys, all forms	7	6	Mainly from France.
Platinum-group metals and silver metal, including alloys:			
Platinum group, troy ounces	64	418	France 257; West Germany 161.
Silver, do	r 97,173	32,697	France 21,927; Switzerland 5,176.
Tin metal including alloys, all forms	52	92	Malaysia 50; Belgium-Luxembourg 16; France 16.
Titanium oxide	511	393	West Germany 98; France 95; Belgium-Luxembourg 90.
Zinc:			
Oxide	r 423	173	France 97; West Germany 47; Belgium-Luxembourg 27.
Metal including alloys, all forms	1,337	1,009	Finland 280; France 268.
Other:			
Ore and concentrate, n.e.s	r 2,852	(1)	All from France.
Oxides, hydroxides, and peroxides of metals, n.e.s	215	191	France 89; United States 70; West Germany 31.
Base metals including alloys, all forms, n.e.s	31	47	Italy 25; People's Republic of China 10; Belgium-Luxembourg 10.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	89	106	Italy 63; France 43.
Grinding and polishing wheels and stones	296	254	Italy 134.
Asbestos	1,019	1,619	U.S.S.R. 677; Canada 274; Italy 150.
Barite and witherite	5,702	4,949	France 2,655; Morocco 1,494; Greece 800.
Boron materials:			
Crude natural borates	3	42	Mainly from United States.
Oxide and acid	73	181	Italy 101; Japan 79.
Cement	444,083	527,353	Romania 248,184; Spain 190,898.
Chalk	971	395	Mainly from France.
Clays and clay products (including all refractory brick):			
Crude clays	r 18,701	18,312	France 8,029; Morocco 3,193; United Kingdom 2,757.
Products:			
Refractory	5,598	7,698	France 1,998; West Germany 1,725; Italy 999.
Nonrefractory	45	24	All from France.
Diatomite and other infusorial earth	104	137	France 107; West Germany 30.
Feldspar and fluorspar	1,458	800	Italy 500; France 300.

See footnotes at end of table.

Table 3.—Tunisia: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Fertilizer materials:			
Manufactured:			
Nitrogenous	69,515	80,974	United Kingdom 24,900; France 18,842; Poland 18,410.
Phosphatic	(1)	(1)	All from France.
Potassic	18,739	14,794	France 9,078; Belgium-Luxembourg 5,715.
Other including mixed	6	41	Mainly from France.
Ammonia	310	194	Do.
Graphite, natural	1	3	Mainly from Italy.
Gypsum and plasters	40	171	Mainly from France.
Lime	25	(1)	All from France.
Magnesite	4	5	West Germany 3; France 1; United States 1.
Mica, all forms	47	29	Italy 26; France 3.
Pigments, mineral, including processed iron oxides	101	166	West Germany 129; France 27.
Pyrite (gross weight)	--	5,000	All from U.S.S.R.
Salt and brine	2	2	Mainly from France.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	6,289	15,406	France 2,944; Italy 2,826; Spain 1,113.
Caustic potash and sodic and potassic peroxides	71	16	West Germany 8; France 6; Sweden 2.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	5,570	7,794	Italy 7,261; Spain 310.
Worked	280	63	Italy 38; France 25.
Dolomite, chiefly refractory grade	115	121	France 68; Italy 53.
Gravel and crushed rock	2,664	6,512	Mainly from Italy.
Quartz and quartzite	1,130	1,004	Mainly from Belgium-Luxembourg.
Sand, excluding metal bearing	298	30	All from France.
Sulfur:			
Elemental, all forms	372,977	178,982	Poland 71,034; Canada 70,406; France 27,135.
Sulfuric acid and oleum	6,703	1,162	West Germany 712; France 416.
Talc, steatite, soapstone, pyrophyllite	1,784	2,597	France 2,081; Italy 510.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	62	1,731	Mainly from Italy.
Coal, all grades including briquets	35,531	52,919	United Kingdom 21,665; Morocco 15,170.
Coke and semicoke	141,882	87,027	West Germany 61,792; Italy 20,721.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r 6,500	7,818	Iraq 5,267; Saudi Arabia 2,503.
Refinery products:			
Gasoline ---do---	17	3	All from Netherlands.
Kerosine ---do---	1,250	1,385	Greece 1,015; Italy 339.
Distillate fuel oil ---do---	1,335	1,231	Greece 1,005; Egypt 218.
Residual fuel oil ---do---	(1)	220	Mainly from Greece.
Lubricants ---do---	119	136	Italy 110; France 17.
Mineral jelly and wax ---do---	r 7	121	Mainly from Italy.
Bitumen ---do---	105	93	Do.
Other ---do---	r 274	203	Greece 100; Italy 42.
Total ---do---	r 3,107	3,392	

r Revised.
1 Less than ½ unit.

COMMODITY REVIEW

METALS

Iron and Steel.—For the second consecutive year iron ore production decreased, declining 20% in 1976 from the 1975 output. With depletion of Tunisian hematite-type iron ore deposits, reserves of iron carbonate had to be utilized, which required more expensive underground mining. Tunisian exploitable iron carbonate reserves were estimated at about 14 million tons; however, only one-third of this reserve was located above the water table, and the remainder had to be mined at higher costs.

Under the fifth plan, the iron and steel industry was allocated $6 million for iron ore mine development, a sintering plant, and replacement of old equipment. The El Fouladh steel mill, constructed in 1966, with an annual capacity of 60,000 tons of finished products, had increased its capacity by 1976 to 140,000 tons. Under the fifth plan it was anticipated that plant capacity would reach 180,000 tons by 1980. An electric arc furnace of 30,000-ton capacity was to be in operation by mid-1977. All iron ore requirements for El Fouladh were mined domestically, while all the needed coking coal was imported.

Lead.—Lead ore production (43% to 55% Pb) decreased 5% in 1976, from 17,825 tons to 17,000 tons. Refined lead metal production increased 0.3% from 23,396 tons in 1975 to 23,476 tons in 1976. The slight increase in lead metal production was due to imports of lead ore from neighboring countries. Lead ore imports in 1976 were 5,000 tons from Belgium and 3,000 tons from West Germany. Refined lead metal was exported to the following countries: Italy, 8,000 tons; Greece, 7,000 tons; Algeria, 3,000 tons; and smaller amounts to five European countries. All the lead ore was produced by the Government-owned mining company Société Tunisienne d'Expansion Minière (SOTEMI).

Zinc.—The Fradj Hassan mine started limited production of zinc ore during the year. Total Tunisian zinc ore production (45% to 55% Zn) increased 3.7% from the 1975 output of 12,917 tons to 13,400 tons in 1976. Production of refined zinc metal was reportedly 618 tons for the year, well below the capacity of the plant which was undergoing repair. Most of the zinc metal production was used locally, whereas zinc concentrates were exported primarily to France.

Other Metals.—As a byproduct of lead-zinc smelting, some silver recovery was reported by SOTEMI.

NONMETALS

Cement.—Production of cement decreased 22.4% in 1976, owing to technical difficulties in the plants and to losses attributed to old equipment generally. New cement production capacity was given priority status in the fifth plan, including expansion of the Bizerte and Djebel Djelloud plants. Two new plants, one at Gabes with 700,000 tons annual capacity, which was well underway in 1976, and the other at Thala near Algerian border, with 1 million tons capacity, were to be producing cement by 1980. Demands of the construction industry were so intense that the Tunisian Government was obliged to import more than 500,000 tons of cement during 1976.

A decision was made in the latter part of the year to install a new plant at Bizerte for manufacturing asbestos cement products, primarily pipe. The plant, which was to produce 21,000 meters of pipe for irrigation and sanitation purposes by 1979, would cost $10 million, and was to be financed by a group of private investors, Ciment-Amiante-Tunisia.

Fertilizer Materials.—Production of phosphate rock, primarily consisting of the higher 65% to 68% BPL grade (bone, phosphate, lime), by Cié. des Phosphates de Gafsa (CPG), decreased 5.7% in 1976 from the 1975 output. The decrease was largely due to lower prices of phosphate rock and generally unfavorable world economic conditions. Production of hyperphosphate in 1976 reached about 90,000 tons from 9,000 tons in 1975, apparently owing to the repair of the plant in 1975. Output of simple superphosphate decreased about 4% while production of triple superphosphate increased 90% in 1976. Tunisia's early diversification into intermediate and finished fertilizer products for export gave rise to a larger domestic phosphate rock

demand. During 1976, the domestic phosphate industry consumed 1.2 million tons of raw material. The growing preference among fertilizer producers for imported intermediate products led to a massive growth in phosphoric acid trade in 1976 which allowed Industries Chimique Maghrebines (ICM) to increase exports of acid by 130%. ICM's second phosphoric acid plant at Gabes, which came on stream in late 1974 but was not effectively utilized in 1975, worked at nearly full capacity throughout 1976. The Société d'Engrais Phosphates et Azotes (SEPA) project, which was to incorporate the construction of additional phosphoric acid facilities at Gabes, would further augment domestic phosphate rock requirements beginning in 1979.

During the next 5 years, CPG was to implement plans to double the level of production achieved in 1976, with a target of about 7 million tons of phosphate rock per year by 1981. The bulk of this increase was to be contributed by two mines—Kef es Schfair and Sehib, the former an open-cast mine, and the latter an underground operation. The mining operation at Kef es Schfair, which was carried out by a contractor and produced 536,000 tons in 1976, was to be taken over gradually by CPG engineers, who expected to produce 2.2 million tons per year by 1981. Also by 1981, the Sehib mine was expected to yield 2 million tons. The remaining expected increase of phosphate rock production was to come from the Mdilla and M'rata mines, both located in the Gafsa Basin. Concurrently with these expansions of phosphate rock production, four new washing plants, which were in different stages of construction, were to come into operation. Those at Sehib, Mdilla, and Maulares were slated to start operation in 1979, while the plant at Matlaoui, which would be the fourth at this location, was to be operational in mid-1980.

Outside the Gafsa Basin, CPG's Kalaa Djerda mine was to be expanded to produce 240,000 tons of phosphate rock per year from 1978 onwards. Construction of a washing plant at the Kalaa mine was under consideration during 1975, but no firm decision was made.

Fluorspar.—Fluorspar output rose again in 1976, reaching 34,800 tons, a 3% increase from the 1975 level. Most of the fluorspar was earmarked for export. However, starting in the latter part of 1976, Tunisia began processing the raw material domestically. Industries Chimiques du Fluor's (ICF) aluminum fluoride plant at Gabes, constructed by Heurtey Industris at a cost of about $14 million, started initial tryouts in 1976. ICF signed a contract with SOTEMI for the supply of 31,000 tons of granular fluorspar per year.

SOTEMI's mine is 45 kilometers south of Tunis near the city of Zriba. Fluorspar mineralization occurs along the bedding planes of dense, gray limestone and is associated with a high percentage of barite. The barite is accumulated with other waste material in ponds. The processing plant consists of grinding, screening, and 12 flotation cells and produces granular fluorspar mainly for European markets.

Other Nonmetals.—Barite production as a byproduct of fluorspar mining increased 57% in 1976 over the 1975 output. Most of the barite accumulated in waste ponds at fluorite mine sites. SOTEMI had not been able to find a market for this byproduct. Lime production increased 12%, reflecting a substantial amount of construction activity, while marine salt production decreased 31% during 1976.

MINERAL FUELS

Natural Gas.—Production of natural gas decreased about 50% to 450 million cubic meters in 1976. Of this amount, about 214 million cubic meters was consumed by domestic industries for power generation and industrial processes, while 166 million cubic meters was flared. Almost all the production was from El Borma Field, and the contribution of the Cap Bon gasfield was small. The newly discovered oilfields and gasfields in the Gulf of Gabes (1975) remained untouched in 1976, owing to the objection from neighboring Libya, which also claimed ownership. By yearend, the border dispute over the oilfields and gasfields in the Gulf of Gabes was submitted to the International Court of Justice at The Hague. With further drilling, the reserves of natural gas were increased from 50 billion cubic meters to 150 billion cubic meters during the year. The Government of Tunisia intended, as part of its fifth plan, to use this energy source in the petrochemical industry, cement plants, steel facilities, and power-generating stations. Engineering

studies for most of these projects were finalized in 1976, and the Government intended to open bids for them in 1977. Initial production in 1981 is expected at the level of 2 billion cubic meters, rising to 5 billion cubic meters by 1990.

The construction of a natural gas pipeline from Algerian gasfields to a port on Sicily, through Tunisia, remained in the discussion stage. Apparently, the level of transportation fees which Algeria would pay to the Tunisian Government was the stumbling block, and no agreements were reached by yearend.

Petroleum.—Crude petroleum production decreased 19.5% in 1976 from the 1975 output. Ashtart and El Borma were the leading producing fields; contributions from Douleb and Sidi El Itayem were similar to those of 1975. Exploration and drilling activities onshore and offshore in 1976 were the same as in 1975. In the offshore Isis oilfields, where a promising showing was found in 1974, work came to a standstill owing to the dispute over ownership between Libya and Tunisia. The dispute was finally submitted to the International Court of Justice at The Hague, and both countries agreed to adhere to the Court's decision.

The output of the country's only refinery at Bizerte in 1976 was used domestically and was supplemented by a total of about 520,000 tons of imported product. The imported products included 218,000 tons of kerosine and 190,000 tons of distillate fuel oil. The export of petroleum products was minimal.

The Mineral Industry of Turkey

By E. Shekarchi [1]

Based on calculations made by Maden Tetkik ve Arama Enstitüsü (MTA) (Mineral Research and Exploration Institute), Turkey's gross national product (GNP) for 1976 was estimated at $40.1 billion [2]; the share of the mining industry was put at $445 million. Thus, as in 1975, the mining industry's direct contribution to the GNP was only 1.1%. However, MTA pointed out that this figure was restricted to mining and that the contributions of smelting and refining to produce products such as aluminum, blister copper, ferrochromium, and mercury were not taken into consideration. Applying the multiplier effect of the mining industry's contribution of fostering secondary industries such as manufacturing, the share was calculated at about $6 billion or roughly 14.5% of the total. MTA expected a significant increase in both direct and indirect contributions as soon as desired levels of production of iron ore and phosphate rock were achieved, indigenous and external demand for industrial raw materials increased, and lignite production met total demand of thermoelectric plants.

Although continuing to struggle with high inflation, rising unemployment, and growing external deficits, the Turkish economy nevertheless showed real dynamism in 1976. Figures released by the State Institute of Statistics indicated a real annual growth rate of 7.2% for the year. The 1976 figure, although below the 5-year plan projections, indicated that since 1971, in spite of internal problems, the international recession, and high energy costs, Turkish economic growth in real terms averaged an increase of over 7% per year.

Faced with the need to insure continuity in its planned economic development (which would call for a 6.8% annual increase in energy consumption) at the lowest possible price, Turkey initiated attempts to develop to the maximum its most promising alternative indigenous resources of energy in 1976. The plan included acceleration of exploration of lignite fields and research on various projects for better consumption of lignite; development of two nuclear power stations (600 and 900 megawatts); exploration for more uranium reserves; research in the field of geothermal energy, including a 0.5-megawatt pilot turbine already in service; and setting up a solar energy coordination board.

Over the past 30 years, Turkey expanded its road network to more than 37,000 miles; however, only about 2,000 miles were built to modern two-lane geometric standards. Turkey planned to participate in a $14 billion project for construction of a trans-European highway, extending through 10 countries from Gdánsk, Poland, to Karāchi, Pakistan, passing through Iran and Turkey. Negotiations for financing this project through the World Bank continued during 1976.

The State-owned MTA remained the main research and development organization on mining, exploration, geology, and metallurgy during the year. The budget of MTA for 1976 was about $87 million, of which $16 million was spent for exploration of metallic ores and $13 million for materials related to energy. MTA's exploration program for 1976, deviating from the previous practice of working on a wide range of minerals, gave priority to

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[2] The Turkish lira (LT) was devaluated in October 1976 from LT16=US$1.00 to LT16.5=US$1.00.

those most critical to Turkish industry—coal, iron, copper, and phosphates. Minerals such as molybdenum and tungsten, actively pursued in the 1975 program, were deleted from the 1976 program.

Turkey placed great emphasis on the urgent necessity of achieving industrial maturity prior to obtaining full membership in the European Communities (EC) in 1995. High priority was placed in the country's development plans on the processing of ores by the national industry before export. Efforts toward this goal were being made by several major State and private organizations: Etibank, Türkiye Komuleri Işletmesi Kurumu (TKI) (Turkish coal works), Black Sea Copper Co., Cinkur Kursun Metal Sanayii A.S. (CINKUR), Metas Mining Ltd., Türkiye Demir ve Çelik Işletmaleri (Turkish iron and steel works), the Turkish cement industry, and Ereğli Demir ve Çelik Fabrikalari T.A.S. (ERDEMIR) (Ereğli iron and steel works).

PRODUCTION

Mining activities in Turkey stagnated during 1976, although earnings from mineral production were higher. Production of some of the foreign exchange earners for the country, such as boron, chromite, lead, and mercury, was down, whereas production of antimony, barite, clays, copper, sulfur, and zinc was higher compared with 1975 figures.

Table 1.—Turkey: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum:			
Bauxite	r 664,908	558,192	461,044
Alumina	123,684	81,708	138,732
Metal	1,900	16,500	37,400
Antimony:			
Ore, mine output:			
Gross weight	40,573	24,562	29,641
Metal content	5,924	3,586	4,328
Regulus	543	850	NA
Chromite:			
Gross weight (34% to 43% Cr_2O_3)	726,036	945,984	839,124
Salable product	316,200	450,000	e 396,000
Copper:			
Mine output, metal content	r 48,000	34,200	38,600
Metal:			
Smelter	r 29,100	26,950	28,099
Refined	29,600	25,200	28,000
Iron and steel:			
Iron ore, gross weight thousand tons	r 2,285	2,296	3,366
Pig iron and ferroalloys:			
Ferrochromium e	9,500	9,500	10,000
Pig iron and other ferroalloys thousand tons	r 1,326	1,359	1,992
Crude steel (including castings) do	1,458	1,457	1,457
Lead:			
Mine output, metal content [1]	4,842	4,693	3,532
Smelter	5,600	2,200	3,200
Manganese ore, gross weight	r 3,552	34,800	20,652
Mercury 76-pound flasks	r 8,833	5,311	4,529
Zinc, mine output, metal content [2]	31,600	26,100	41,200
NONMETALS			
Abrasives, natural, emery	r 150,780	71,904	66,912
Asbestos	r 15,588	15,492	9,156
Barite	r 48,720	65,544	176,976
Boron minerals	r 1,080,480	964,200	912,960
Cement, hydraulic thousand tons	8,940	10,860	12,336
Clays:			
Bentonite	13,420	32,656	21,126
Kaolin	r 25,000	34,535	65,611
Other	77,612	87,337	94,178
Fertilizer materials	574,250	537,612	924,798
Fluorspar	1,428	1,405	e 1,500
Gypsum e thousand tons	357	r 434	493
Magnesite, crude ore	r 520,764	474,888	405,288

See footnotes at end of table.

Table 1.—Turkey: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS—Continued			
Meerschaum ---kilograms--	r 21,000	24,600	8,400
Perlite	17,963	11,927	22,874
Pyrite, cupreous, gross weight	76,249	23,640	84,630
Salt, all types ---thousand tons--	913	64	79
Sodium sulfate	55,504	80,431	87,637
Stone, sand and gravel, n.e.s.:			
Limestone ---thousand tons--	[3] 428	7,000	16,283
Marble	28,900	18,700	NA
Quartzite	e 120,000	NA	NA
Sand, siliceous	31,226	29,112	19,336
Shale (argillite)	e 15,000	NA	NA
Sulfur:			
Native, other than Frasch	r 19,056	19,452	21,000
Content of pyrite	35,456	10,874	38,930
Byproduct	45,000	61,000	69,000
Total	99,512	91,326	128,930
Wollastonite	e 10,000	NA	NA
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural ---thousand tons--	r 394	457	443
Coal:			
Bituminous ---do----	r 4,704	4,586	3,896
Lignite ---do----	5,382	6,135	5,816
Coke and semicoke:			
Metallurgical ---do----	r 1,241	1,260	1,674
Gashouse e ---do----	32	r 72	e 150
Breeze ---do----	e 110	72	
Total ---do----	r 1,383	1,404	1,824
Gas, natural:			
Gross production e ---million cubic feet--	r 4,900	r 4,600	5,200
Marketed production e ---do----	r 2,450	r 2,300	2,600
Petroleum:			
Crude ---thousand 42-gallon barrels--	23,661	22,167	19,020
Refinery products:			
Gasoline ---do----	16,454	16,899	16,660
Jet fuel ---do----	2,855	2,080	1,424
Kerosine ---do----	3,999	3,204	4,030
Distillate fuel oil ---do----	23,658	23,503	24,573
Residual fuel oil ---do----	36,537	37,865	35,771
Lubricants ---do----	257	511	903
Other:			
Liquefied petroleum gas ---do----	4,659	4,298	4,025
Naphtha ---do----	2,756	2,949	3,230
Petroleum asphalt ---do----	1,448	1,765	1,736
Unspecified ---do----	161	101	714
Refinery fuel and losses ---do----	1,896	3,167	4,088
Total ---do----	94,680	96,342	97,154

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Total content of material reported as run-of-mine lead ore and lead-zinc ore; excludes lead content of material reported as run-of-mine zinc ore.

[2] Total content of material reported as run-of-mine zinc ore and lead-zinc ore; excludes zinc content of material reported as run-of-mine lead ore.

[3] Does not include limestone used in the manufacture of cement.

TRADE

The value of mineral exports increased 11% to approximately $130 million. The proportionate value of minerals in Turkey's overall export trade fell from 8.3% to 6.5% in 1976.

An export boom in early 1976 was artificially stimulated by Turkey's sale of accumulated stocks of raw materials, and was accompanied by a rise in imports of only 5%. This resulted in a 13% reduction in the trade deficit for the first 9 months of 1976, and a total deficit for the entire year somewhat lower than in 1975. Workers' remittances from abroad fell to about $1.2 billion, some $150 million below the planned level. Consequently, major borrowing was still required to balance the year's deficit, and the country's debt commitments continued to rise.

Table 2.—Turkey: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Ore and concentrate	187,400	75,000	All to U.S.S.R.
Oxide and hydroxide	101,175	36,657	Do.
Metal, semimanufactures	21,446	3,093	Saudi Arabia 1,377; Kuwait 1,164.
Antimony:			
Ore and concentrate	13,174	1,766	U.S.S.R. 1,005; Yugoslavia 461; West Germany 300.
Metal including alloys, all forms	545	265	Bulgaria 170; Jordan 25.
Arsenic, natural sulfides	--	5	All to Algeria.
Chromium ore and concentrate	645,896	648,484	United States 169,442; Japan 90,889; Switzerland 67,795.
Copper including alloys:			
Unwrought	r 13,270	5,540	Spain 4,540; Belgium-Luxembourg 1,000.
Semimanufactures	r 1	--	
Iron and steel metal:			
Ferroalloys	9,388	6,364	Netherlands 3,044; United States 1,700.
Semimanufactures	r 24,194	14,589	Syria 4,785; Iran 3,274.
Lead ore and concentrate	40,973	6,625	Italy 3,875; Bulgaria 1,750; West Germany 800.
Manganese ore and concentrate	2,000	--	
Mercury ---76-pound flasks	4,616	96	All to Iraq.
Molybdenum ore and concentrate	18	18	All to Sweden.
Tungsten ore and concentrate	(1)	9	All to United Kingdom.
Zinc:			
Ore and concentrate	r 33,393	51,548	Italy 17,000; West Germany 10,810; Bulgaria 10,070.
Metal, semimanufactures	96	--	
Other:			
Ores and concentrates	1,500	--	
Metals including alloys, all forms	r (2)	--	
NONMETALS			
Abrasives, natural, n.e.s	89,427	58,719	France 36,580; United Kingdom 15,084; Netherlands 7,055.
Barite	69,573	35,406	U.S.S.R. 11,769; West Germany 9,562; United States 5,000.
Boron materials:			
Crude natural borates	664,461	391,215	Italy 122,733; France 49,495; West Germany 35,098.
Oxide and acid	11,368	7,247	West Germany 2,954; Netherlands 1,048; Poland 1,000.
Cement ---thousand tons	292	848	Syria 331; Iran 185; Libya 175.
Chalk	4,084	3,296	Libya 2,400; Lebanon 369.
Clays and clay products:			
Crude:			
Bentonite	2,420	10,200	Iraq 9,800.
Kaolin	13,285	1,506	Lebanon 1,478.
Other	--	30	All to Syria.
Products:			
Refractory	646	325	All to Iran.
Nonrefractory	1,480	59	Mainly to Syria.
Diatomite and other infusorial earth	12,348	160	All to Iran.
Gypsum	1,500	1,500	All to Libya.
Lime	11,127	878	Do.
Magnesite:			
Crude	2,970	14,650	Greece 5,900; Austria 5,250.
Calcined	89,949	63,648	Austria 45,100; Greece 6,390.
Pyrite (gross weight)	18,130	--	
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked, calcareous	14,920	12,025	Italy 4,671; Syria 2,198; Lebanon 1,738.
Worked	19	6	Switzerland 4.
Dolomite	73	30	Iran 12; Greece 10.
Talc	125	179	Libya 60; Iran 47; Lebanon 21.
Other:			
Crude, meerschaum, amber, jet	3	12	West Germany 5; Austria 4.
Slag, dross, and similar waste, not metal bearing	200	--	
Unspecified	37,030	16,652	Belgium-Luxembourg 12,750; United Kingdom 2,450.

See footnotes at end of table.

Table 2.—Turkey: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
MINERAL FUELS AND RELATED MATERIALS			
Coal, coke, briquets	300	200	All to Iraq.
Hydrogen, helium, rare gases	13	5	West Germany 2; Israel 2.
Petroleum refinery products:			
Gasoline ----thousand 42-gallon barrels--	4,253	2,026	Sweden 1,055; West Germany 492.
Kerosine and jet fuel ----------do----	1,492	659	Netherlands 571; West Germany 88.
Distillate fuel oil ----------do----	254	--	
Lubricants ----------do----	r (2)	--	
Other ----------do----	r (2)	1	All to Syria and Iran.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	550	126,746	Italy 73,428; Netherlands 38,620; France 14,698.

r Revised.
1 Revised to none.
2 Less than ½ unit.

Table 3.—Turkey: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Oxide and hydroxide	451	1,184	U.S.S.R. 976; West Germany 158.
Metal:			
Scrap	121	395	Kuwait 275; France 120.
Unwrought	r 50,266	51,681	Canada 13,028; Romania 9,644; Italy 6,583.
Semimanufactures	2,400	2,659	West Germany 577; France 345; Sweden 344.
Arsenic trioxide, pentoxide, acids	63	90	United Kingdom 70; West Germany 20.
Cadmium metal including alloys, all forms	12	19	West Germany 11; Netherlands 4.
Chromium oxide and hydroxide	132	243	Italy 63; West Germany 37; United States 34.
Cobalt:			
Oxide and hydroxide	12	17	Mainly from Belgium-Luxembourg.
Metal including alloys, all forms	(1)	1	Mainly from United States and United Kingdom.
Copper:			
Ore and concentrate	--	2	All from Netherlands.
Metal:			
Scrap	10	498	Belgium-Luxembourg 413.
Unwrought	r 354	1,275	Belgium-Luxembourg 851; West Germany 365.
Semimanufactures	r 12,483	5,725	Italy 1,706; West Germany 1,420.
Iron and steel:			
Ore and concentrate -----thousand tons--	310	234	Mainly from Brazil.
Metal:			
Scrap ----------do----	118	85	United States 70; West Germany 7.
Pig iron, ferroalloys, similar materials ----------do----	76	134	Switzerland 28; Japan 21; U.S.S.R. 17.
Primary forms ----------do----	r 414	738	West Germany 292; Switzerland 109; Japan 48.
Semimanufactures:			
Bars, rods, angles, shapes, sections ----------do----	r 490	504	West Germany 202; Switzerland 109; Japan 48.
Universals, plates, sheets--do----	r 477	280	Japan 100; West Germany 40; Italy 31.
Hoop and strip ----------do----	5	5	West Germany 2; Japan 2.
Rails and accessories -----do----	63	18	United Kingdom 9; France 8.
Wire ----------do----	r 8	9	West Germany 4; Japan 3.
Tubes, pipes, fittings -----do----	r 23	117	West Germany 77; Italy 14; Japan 10.
Castings and forgings ----do----	2	1	Mainly from West Germany and Italy.

See footnotes at end of table.

Table 3.—Turkey: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Lead metal including alloys:			
Scrap	1,829	2,069	United States 1,694; United Kingdom 307.
Unwrought	9,192	4,724	United Kingdom 2,551; Yugoslavia 951.
Semimanufactures	r 453	270	Canada 217; West Germany 44.
Magnesium metal including alloys:			
Unwrought	229	161	Norway 123; West Germany 18.
Semimanufactures	1	3	West Germany 2.
Manganese:			
Ore and concentrate	3,381	4,852	Belgium-Luxembourg 4,715.
Oxides	531	823	Japan 621; West Germany 74.
Metal	11	61	South Africa Customs Union [2] 50; Japan 10.
Nickel:			
Matte, speiss, similar materials	r 180	332	Netherlands 143; United Kingdom 134.
Semimanufactures	r 105	179	West Germany 95; Italy 16.
Platinum-group and silver metals including alloys:			
Platinum-group ——troy ounces	3,279	611	West Germany 547.
Silver ——do	127,574	140,756	West Germany 76,583; France 28,936.
Tin:			
Oxides	23	22	Mainly from West Germany.
Metal including alloys, all forms	1,124	1,176	United Kingdom 543; Switzerland 341.
Titanium:			
Ore and concentrate	502	2,132	Australia 1,159; Netherlands 338.
Oxides	1,538	2,035	West Germany 436; Finland 383; France 286.
Zinc:			
Oxides	3,383	2,505	West Germany 784; Netherlands 678; France 473.
Metal including alloys:			
Scrap	150	130	All from Belgium-Luxembourg.
Unwrought	r 22,597	17,384	Belgium-Luxembourg 5,465; West Germany 4,209; United Kingdom 3,917.
Semimanufactures	r 453	915	Belgium-Luxembourg 274; West Germany 180; Poland 106.
Zirconium ore and concentrate	17	37	Netherlands 30; Spain 5.
Other:			
Ash and residue containing nonferrous metals, n.e.s	596	440	United States 342; Lebanon 79.
Oxides, hydroxides, peroxides of metals, n.e.s	105	171	West Germany 98; United States 20.
Metals:			
Alkali, alkaline earth, rare-earth metals	134	1	Mainly from France.
Base metals including alloys, all forms, n.e.s	18	8	West Germany 4; United States 2.
NONMETALS			
Abrasives, natural, n.e.s.:			
Crude	12	(1)	All from Spain and West Germany.
Dust and powder of precious and semiprecious stones ——kilograms	5,006	1,907	People's Republic of China 1,900.
Grinding and polishing wheels and stones	1,132	585	West Germany 124; Italy 83; Yugoslavia 60.
Asbestos, crude	14,584	16,357	U.S.S.R. 7,333; Canada 2,684.
Cement	612	1,811	Italy 800; West Germany 513; United Kingdom 200.
Chalk	3	92	All from United Kingdom.
Clays and clay products:			
Crude:			
Bentonite	26	27	West Germany 10; Netherlands 8.
Kaolin	2,599	5,334	Canada 3,039; West Germany 1,694.
Other	440	324	Netherlands 179; U.S.S.R. 62.
Products:			
Refractory (including nonclay bricks)	r 40,058	32,348	U.S.S.R. 9,303; Australia 8,597; West Germany 7,622.
Nonrefractory	r 14	66	West Germany 50; Netherlands 8.

See footnotes at end of table.

Table 3.—Turkey: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Diamond, gem and industrial thousand carats	59	57	Netherlands 44; United Kingdom 12.
Diatomite and other infusorial earth	292	232	West Germany 117; Italy 60.
Feldspar	96	85	Sweden 73; West Germany 10.
Fertilizer materials:			
Crude:			
Nitrogenous	(1)	--	
Phosphatic	590,994	905,267	Morocco 385,405; Tunisia 330,667; Jordan 142,953.
Manufactured:			
Nitrogenous	r 376,545	173,610	Lebanon 64,665; U.S.S.R. 59,679.
Phosphatic	10,298	1,384	All from Australia.
Potassic	176	5	West Germany 3.
Other	421,901	86,027	Australia 23,621; France 23,360; U.S.S.R. 22,167.
Fluorspar	r 653	160	All from United Kingdom.
Graphite, natural	517	573	West Germany 444; Norway 102.
Gypsum	--	2	All from United Kingdom.
Lime	80	83	All from West Germany.
Magnesite	5	--	
Mica:			
Crude	53	104	West Germany 45; Austria 26; Netherlands 25.
Worked	r 30	29	Spain 22; West Germany 3.
Pigments:			
Mineral	r 5	5	Australia 2; Denmark 2.
Processed iron oxides	198	210	West Germany 192.
Precious and semiprecious stones, except diamond kilograms	5,890	4,675	East Germany 4,450.
Pyrite (gross weight)	77,191	100,453	Cyprus 99,323.
Salt	14	25	West Germany 22.
Sodium and potassium compounds:			
Caustic soda	21,625	24,276	Italy 16,899; Romania 4,095.
Caustic potash	400	829	Italy 420; France 225; Romania 82.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	6	--	
Worked	1	--	
Dolomite	2	--	
Gravel and crushed rock	178	339	France 317.
Quartz and quartzite	394	421	Netherlands 113; Sweden 95; West Germany 68.
Sand, excluding metal bearing	11	2	All from United States.
Sulfur:			
Elemental:			
Other than colloidal	210	2,004	Switzerland 2,000.
Colloidal	131	634	Switzerland 504; France 115.
Sulfuric acid	129,407	354,792	Switzerland 261,845; West Germany 62,728.
Talc	549	410	Italy 335; West Germany 73.
Vermiculite	1	20	Mainly from Austria.
Other:			
Crude	r 597	636	West Germany 508; Netherlands 65.
Oxides and hydroxides of magnesium, strontium, barium	113	194	Italy 73; U.S.S.R. 50.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	69	50	United Kingdom 40; West Germany 5.
Carbon black	16,919	5,234	Italy 3,131; Israel 534.
Coal, including briquets	1,636	26,161	Mainly from United States.
Coke	161,838	--	
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	74,936	59,159	Iraq 45,308; Saudi Arabia 9,101.
Refinery products:			
Gasoline do	49	72	Italy 46; United Kingdom 26.
Kerosine and jet fuel do	1	2	Netherlands 1.
Distillate fuel oil do	--	510	All from Romania.
Residual fuel oil do	1,918	3,122	Canada 1,073; Japan 867; Netherlands 346.

See footnotes at end of table.

Table 3.—Turkey: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum—Continued			
Refinery products—Continued			
Lubricants			
thousand 42-gallon barrels	938	706	United Kingdom 196; Netherlands 166; United States 134.
Other:			
Liquefied petroleum gas---do	550	1,512	Italy 589; Kuwait 301; Libya 220.
Mineral jelly and wax ---do	32	47	West Germany 24.
Unspecified ---do	46	3	Mainly from West Germany.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	1,376	28,718	United States 17,982; West Germany 8,213.

r Revised.
1 Less than ½ unit.
2 Includes the Republic of South Africa, Botswana, Lesotho, Swaziland, and the Territory of South-West Africa.

Table 4.—Turkey: Consumption, production, exports, and imports of mineral commodities, by group
(Thousand metric tons)

	1975	1976
Consumption:		
Metals	5,113	6,337
Nonmetals	161,563	177,690
Mineral fuels	27,650	31,701
Production:		
Metals	5,645	6,952
Nonmetals	161,563	176,704
Mineral fuels	17,673	19,195
Exports:		
Metals	784	836
Nonmetals	711	965
Mineral fuels	(1)	82
Imports:		
Metals	493	658
Nonmetals	935	1,981
Mineral fuels	9,660	12,588

1 Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—According to MTA calculations, Turkey possessed 4% of the world's known bauxite reserves, yet in 1976 it accounted for less than 1% of world production. Production of bauxite was 17.4% below the 1975 level.

The Seydisehir Integrated Aluminum (SIA) plant, financed by the U.S.S.R. and operated by Etibank since 1973, was expected to produce 200,000 tons of alumina, 60,000 tons of aluminum, and 34,000 tons of semifinished products annually when in full operation. However, construction difficulties and sharply increased prices for caustic soda and petroleum coke hampered the effort to achieve full production. The SIA plant primarily processed the boehmite and gibbsite types of bauxite found near the city of Seydisehir. There were reportedly substantial additional resources at Milas in Muğla Province in the form of diasporite as well as large reserves in the central Taurus region. Etibank, a major shareholder in SIA, made plans to double its production to 120,000 tons of aluminum ingot. The plant expansion was to cost an estimated $200 million.

Antimony.—Antimony mineralization is generally associated with mercury in Turkey. Total reserves of antimony from four different mines were given at approximately 1 million tons, of which about one-fourth was located in the Tokat area. In 1976, the main production came from the Turhal mine near Tokat, central Anatolia.

Tokat ore averaged about 14% antimony, whereas that at the other mines ranged from 5% to 6% antimony. Antimony production increased 21% in 1976. The mine setup and the presence of considerable reserves suggested that, if demand were higher, the Turhal mine production could be doubled.

Chromite.—Ultrabasic rocks with which chrome ore is associated occur in about 4% of the area of Turkey. Over 2,000 occurrences of alpine-type chromite mineralization in the form of pods and lenses were known in 1976. Two chrome ore-bearing belts were recognized: The northern belt extended from Bursa through Eskişehir and Sivas to Erzincan, while the southern belt extended from Muğla through Denizli, Burdur, and Adana to Elâziğ.

Total chromite ore production from both State and private concerns reached 839,000 tons, a decrease of 11.3% from the 1975 production level. Construction of Etibank's ferrochrome plant at Elâziğ continued during the year and partial production was expected to start in mid-1977. When in full operation, the plant would produce about 50,000 tons of high-carbon ferrochrome per year. The cost of the ferrochrome plant was estimated at $20 million in 1968, but the estimate was revised upward in 1976 to $30 million. In addition to the Elâziğ plant, Etibank operated the Antalya ferrochrome plant during the year and produced about 8,000 tons of ferrochrome, some of which was exported.

Copper.—The year 1976 was a poor one for the copper mining industry in Turkey. Production of copper ore (average grade 1.6% copper) decreased to 1.9 million tons in 1976 from about 2.3 million tons in 1975. Although blister copper production increased 4% in 1976, Turkish copper smelting capacity remained low and the byproduct sulfuric acid from copper smelting was not fully and efficiently consumed by fertilizer plants during 1976. New concentrators or expansion of existing ones were planned for Kure, Cayeli, Siirt, and Murgul to increase the output of concentrate and meet the export demand set by the State Planning Organization.

Gold.—MTA reported gold occurrences at Arpadag near Izmir, at Manisa near Aydin, at Madendag and Kurtaldge near Canakkale, and in Bilecik and Kars Provinces. One of the most intensive exploration programs undertaken in 1975–76 was at Manisa, where gold placer deposits occurred in thick Neogene conglomerates and very interesting values were found. A detailed exploration by MTA was also carried out near Aydin, where the gold occurred in association with arsenopyrite mineralization in mica schists.

No gold production was reported by yearend, and Turkey depended on overseas sources for most of the gold used in its industrial operations.

Iron Ore.—Production of iron ore in 1976 was 3.4 million tons, an increase of 47% over that of the previous year. The 1976 demand for iron ore by Turkey's steel industry was on the order of 7 million tons. It was estimated that demand could increase to 20 million tons per year within the next 10 years. There are three major areas of important iron ore occurrences in Turkey. In Sivas and Malatya Provinces, two substantial occurrences are found, the Divrigi and Hassan Celebi deposits. The Divrigi deposit supplied directly chargeable 57% iron lump ore for the steel industry. Capacity of the mine was to be doubled to 5.2 million tons per year by 1979. The Hassan Celebi deposit, a low-grade ample-tonnage occurrence, was on MTA's development program in 1976. This ore consisted of a low-grade magnetite in nine massive occurrences and occasionally in disseminated form. A feasibility test showed that coarse concentrates could be obtained from the massive bodies that were suitable for sinter feed, while fine concentrates could be obtained from the disseminated ores that were suitable for pelletization. Farther west, a second iron belt of sedimentary origin and with ample supply occurs in Kayseri and Adana Provinces. Although a large tonnage was present in the area, much of it was of low grade, and required some beneficiation before use. The third belt covers an extensive area in the Bitlis Massif in southeastern Turkey. This deposit is associated with metamorphic rocks and generally occurs as magnetite and apatite. Thus, this area was found important not only for iron ore which needed beneficiation, but also for the presence of phosphate in apatite for the fertilizer industry. Obviously, opportunity existed to increase Turkish iron ore

production, and emphasis on production expansion to meet expected demand by 1980 could eventually reduce imports considerably. Turkish imports of iron ore were 234,000 tons in 1975 and about 400,000 tons in 1976; they are expected to increase in the near future.

Iron and Steel.—The performance of the third integrated steelmill at Iskenderun in the first year of operation was commendable. The details of a new agreement between the Turkish Government and Soviet authorities to increase the production capacity of the Iskenderun steel plant 50% were not available by yearend. The installed annual capacity of the plant in 1976 was given at 2 million tons of steel. Production from the Ereğli integrated steel plant, the Karabük steel plant, and the Iskenderun steelworks was a record high 1.9 million tons, of which 474,000 tons was pig iron, 1.5 million tons steel ingot, and about 17,000 tons steel castings. No figures were available on rolled steel by yearend.

Lead-Zinc.—MTA identified three belts of base metal mineralization that not only constitute the most important mining regions of Turkey for copper, lead, and zinc, but exhibit substantial indications of yet unrealized potential. The first of these belts extends along the northern section of the country from the eastern Black Sea region to the tip of western Turkey where it splits into two, one arm extending through northern Thrace into Bulgaria and the other arm passing to the south of the Sea of Marmara through Balikesir. The second belt was identified as being associated with the basic volcanic units of the ophiolite rocks that occur in the southeast of Turkey. In this belt, the most significant of the occurrences are the lead-zinc deposits at Madenkoy in Siirt Province. Extensive exploration activities by MTA in this area were planned for the future. The third belt extends through the central Taurus region of southeastern Turkey. Mineralization here was found to be of the stratabound type and contained lead and barite. To the east of this belt, at Bolkardag and particularly at Zamanti, extensive reserves of zinc carbonate were found and actively exploited during the year. MTA reported reserves of about 1.3 million tons of lead metal content and 3.6 million tons of zinc metal content for all three belts.

Production by the new CINKUR lead-zinc plant at Kayseri in central Anatolia officially started in the latter part of 1976. The plant was to process concentrates from the Zamanti mines to recover 31,000 tons of zinc ingot, 5,000 tons of lead, and about 119,000 troy ounces of silver.

Production of argentiferous lead ore processed by domestic mills in 1976 was about 2,600 tons, a 20% decrease from that of 1975. No figures were available on the production of primary and secondary refined lead. Production of zinc-lead ore, which was sorted by hand in 1976, decreased 5%; production of zinc concentrate declined 16% during the year. It was expected that the full effect of the CINKUR operation on lead-zinc metal production would be apparent in 1977. High tariffs were imposed on zinc imports for 1977 to protect the new industry.

Manganese. — Manganese production from both the private and public sector decreased 41% in 1976. Most of the decrease was of low-grade ore (below 35% manganese), from deposits operated by small private mining companies. There was no ferromanganese production in Turkey during 1976, and almost 5,000 tons of ferromanganese for steel production was imported from Japan, West Germany, and the United States. Generally, manganese deposits in Turkey occur as small lenses, veins, and pods, with only a limited amount of battery-grade ore reported in a few locations. The other occurrences were metallurgical-grade ore with a high percentage of deleterious elements such as phosphorus and zinc.

Mercury.—Mercury production decreased for the second consecutive year; 1976 production of 76,000 tons of mercury ore was 18% lower than that of 1975. The important producers of mercury were the Halikoy and Turkonu mines near Aydin, the Karaburun mine near Izmir, and the Sizma and Sarayonu mines near Konya. Mercury mineralization occurred in western and central Anatolia and it was reported that there were many undeveloped occurrences with considerable reserves. The MTA report maintained that there was no doubt that mercury production could be greatly expanded if world demand were to improve. However, world

demand remained in a decline, owing to the health hazards attributed to mercury.

Tungsten.— The Ulu Dağ tungsten mine and concentrator, a joint venture of Salzgitter A.G. of West Germany and Etibank, the Turkish State-owned mining enterprise, came into production for the first time in 1976. The mine, located at a 2,200-meter elevation in the Ulu Dağ Mountains near the city of Bursa, provided employment for about 1,500 people. Owing to unpredictable road conditions as a result of snow and storms, provisions have been made to sustain operation without outside help for 15 days. The mine produced close to 2,000 tons of scheelite concentrate, which was sent primarily to West Germany for further processing.

A typical chemical analysis of Ulu Dağ scheelite concentrate is as follows: WO_3 65%, copper 0.004%, calcium 10.8%, SiO_2 1.56%, and traces of phosphorus, zinc, arsenic, and bismuth. The concentrator was designed to treat scheelite, the typical ore of the Ulu Dağ mine, at a rate of 560,000 tons annually. Etibank expected the mine and concentrator to be in full operation by 1977. Reportedly, the cost of the project, estimated at $26 million in 1974, was to be increased considerably because of worldwide inflation and a fire at the mine that delayed operation and damaged equipment.

Etibank planned to double the production of the Ulu Dağ mine by 1981, at an estimated cost of $15 million.

Uranium.—Extensive ground and airborne surveys were carried out in the Manisa-Afyon area on the Neogene sediments during 1976. These surveys were a continuation of a previous survey by MTA that had located uranium deposits and had outlined a more detailed exploration target. In 1976, the Government successfully completed the construction of a pilot-plant at Koprubas which produced some yellowcake. Surveys were also being made on the Neogene basins around Thrace and Beypazari near Ankara, where, according to MTA reports, the possibility of finding new uranium resources was excellent.

NONMETALS

Asbestos.—Construction of an asbestos processing plant with a 10,000-ton-per-year capacity by Amyant Sanayii A.S. at Mihaliceik, east of Eşkisehir, continued in 1976. The company expected to go into production by mid-1977. Production of asbestos decreased 6,000 tons in 1976, or 41%. Turkey was obliged to import about 12,000 tons of asbestos, mostly in fiber form, in 1976. No export was reported in 1976.

Barite.—Barit Maden Turk A.S. (BMT) was the only producer of barite in the country during 1976. The new ruling by the Government that after 1976 all barite exports should be in a packaged ground form had a dampening effect on the steady growth of the industry. Owing to shortages of foreign exchange in Turkey in 1976, the company, although willing to follow the Government ruling, was not certain that a grinding mill could be imported, installed, and operational by the end of 1976, so it remained to be seen what effect this situation would have on the export of barite.

Production of run-of-mine barite reached a new high of 20,000 tons in 1976. According to MTA's report, known barite reserves were estimated at 33 million tons of ore at yearend 1977.

Boron.—According to a report by MTA, measured reserves of Turkish boron ore constituted over 80% of the known world reserves in 1976. Most of the boron deposits occur in Neogene lacustrine sediment associated with old volcanic activity. The main boron occurrences are in the region of Kütahya-Eskişehir-Balikesir in western Turkey, where the active mines of Kirka, Emet, and Bigadic are located. Production decreased 5.3% from a 960,000-ton level in 1975 to 910,000 tons in 1976. Turkey challenged the United States as the world's largest producer in 1976, and the two countries competed for the world market, especially in Europe where Turkey benefited from advantages in transportation costs. Diversification of the boron industry continued and Etibank announced plans to construct a 100,000-ton-per-year boric acid plant at Bandirma, near the Sea of Marmara, with a completion date in 1979. It was also planned that the sodium borate treatment plant at Kirka was to eventually include refining facilities to produce 163,000 tons of crude pentahydrate borax, 60,000 tons of crude and refined anhydrous borax, and 15,000 tons of refined decahydrate borax per year. The completion date for these facilities was

scheduled for the end of 1977 or the beginning of 1978.

Cement.—By yearend 1976, Turkey had 34 cement plants with a total capacity of 14.5 million tons. However, cement production by both the private and public sectors amounted to only 12.3 million tons. The regional location of plants, their capacity, and production in 1976 were as follows, in thousand tons:

Region	Number of plants	Annual capacity	Production
Marmara	8	3.8	3.1
Ic Anadolu	8	2.7	1.9
Karadeniz	6	2.3	1.7
Ege	4	1.1	1.1
Akdeniz	3	2.6	1.7
Dogu Anadolu	3	1.0	.7
Guneydogu Anadolu	2	1.2	1.1
Total[1]	34	14.5	12.3

[1] Data may not add to totals shown because of independent rounding.

Although Turkey exported almost 1 million tons of cement to the neighboring countries of Iraq, Iran, and Syria, Turkey itself experienced a shortage of cement during the peak construction season, owing to an inadequate transportation system. Turkey's largest cement plant at Adana was undergoing expansion in 1976, from 900,000 tons to 1.5 million tons per year, slated for completion by yearend 1977. Other major expansions of existing cement plants were underway in 1976, and Turkey expected to have a cement production capacity of 19.2 million tons by 1980.

Fertilizer Materials.—Production of phosphatic fertilizer was reportedly about 597,000 tons in 1976, an increase of almost 200%, while production of nitrogenous fertilizer increased almost twofold over 1975 production. The increases were attributed to the plant expansion of Azot Sanayii T.A.S., which came onstream in 1976, and to the new facilities of Gubre Fabrikalari T.A.S., which became partially operational during the year. Azot Sanayii was in the process of planning a fourth fertilizer complex in Cukrova-Mersin to be operational by 1979. The company expected to annually produce 630,000 tons of sulfuric acid, 215,000 tons of phosphoric acid, 544,000 tons of ammonia, 330,000 tons of urea, and 420,000 tons of ammonium phosphate. Commissioning of the Gubre Fabrikalari fertilizer complex at Iskenderun was successfully completed in 1976. The complex, with an annual capacity of 230,000 tons of sulfuric acid and 75,000 tons of phosphoric acid, was expected to meet the country's acid requirements for the downstream triple superphosphate complex and to eliminate the need for further imports of these acids. A feasibility study on the construction of a fertilizer plant at Rize in northeastern Turkey neared completion in 1976. A company consisting of the Turkish Industrial Development Bank and Rize local administrative and agricultural cooperatives was to be established to operate the plant, but no further details were available by yearend.

Phosphates.—The Mazidag phosphate deposits, located in southeastern Turkey, remained under exploration. Etibank, the owner of the major findings in the Mazidag area, announced in 1976 that a beneficiation plant to upgrade phosphate in the area was under consideration. Etibank predicted that about 250,000 tons of phosphate rock would be required at the plant by 1978, but no details regarding the plant capacity or state of purchase were given. During 1976, all of the phosphate requirements for the Turkish fertilizer industry were met by imports from Morocco, Tunisia, Jordan, and Israel, causing a major drain on foreign exchange.

Magnesite.—Magnesite, which has become an important foreign exchange earner for Turkey, remained at the same export level as in 1975. Production of magnesite, most of which is slated for export, decreased 15% in 1976 reflecting a decline primarily in the production of chemical-grade magnesite rather than of deadburned magnesite. During 1976, a new plant owned by Kütahya Manyezit Işletmeleri A.S. (KUMAS), located at Kütahya in west-central Turkey, started production of deadburned magnesite.

The Government-owned refractory magnesite brick plant at Konya was expanded and produced close to 50,000 tons of brick per year, most of which was consumed domestically in the steel and ferroalloy industries. It was projected that Turkey's consumption of refractory brick by 1985 would triple that of 1976.

Perlite.—Perlite was becoming an export commodity of some significance for Turkey as more uses were found in the building industry as a sound and heat in-

sulator and in the agricultural field as a soil conditioner. Turkey produced about 23,000 tons of perlite in 1976, which was almost double the output of 1975. The principal deposit of perlite was in a belt running through the center of Turkey from west to east; resources appeared to be almost limitless. The most important producing regions were Van, Erzurum, and Nevşehir Provinces, all in the southwest of the country. The deposits were ideally located near excellent transportation routes, should the demand for Turkish perlite in the overseas market increase.

Pyrite.—Demand for Turkish cupreous pyrite increased during the year, and production emerged from the slump of 1975 to reach a new high of about 85,000 tons in 1976. Most of the cupreous pyrite production was exported to West Germany for processing under a barter agreement.

Stone.—*Marble.*—Turkey has long been known as a producer of high-quality marble. The value of marble produced for export has ranged from $4.4 million to $6 million per year. The known primary reserves are located in Denizli, Izmir, Kirşehir, Sivas, and Erzurum Provinces and on Marmara Island. The prized variety produced in Sivas and Erzurum known locally as onyx marble was exported both as unfinished blocks and as finished ornamental products in 1976.

MINERAL FUELS

The Ministry of Energy and Industry put into motion a long term energy program. Coal production, particularly lignite, was to increase about threefold. By 1987, production of hydroelectricity, which in 1976 furnished only 8% of the nation's power, was to be increased 43%. By 1985, one nuclear power station of 600 megawatts-electric was to be in operation, and by 1980, a 15-megawatt-electric geothermal power station was to be operational, provided that exploration obstacles were removed. In the area of research, the Government intended to provide funds and personnel for a bituminous shale extraction project and promote solar energy production on a national basis.

Turkey imported 300 million kilowatt-hours of electrical energy from neighboring Bulgaria and expected to import 500 million kilowatt-hours in 1977 at even higher prices. The electrical power produced in Turkey in 1976 was 16.5 billion kilowatt-hours, whereas consumption reached 16.8 billion kilowatt-hours during the year.

Coal.—The Afsin Elbistan lignite project moved toward reality in 1976. The cost, estimated at $150 million for the entire project including an open cast mine and a thermoelectric powerplant, was financed by the World Bank and a Japanese consortium comprising Nippon Conveyor Co., Ishikawajima-Harima Heavy Industries Co., Ltd., and Mitsubishi Corporation. The Elbistan deposit was estimated to contain about 3 billion tons of lignite. TKI, the Turkish coal works, planned to mine 20 million tons of lignite per year, of which 17.5 million tons was to be used in the thermal plant and 2.5 million tons for other domestic fuel requirements. TKI slated initial production of lignite for late 1978.

In September 1976, at the first National Coal Congress (NCC), it was noted that in the past 16 years, a total of 72 million tons of salable bituminous coal was produced at the Zonguldak coalfields in Turkey. It was also reported that 3.2 million tons of bituminous coal produced in 1975 was used by industry, approximately 1.1 million tons by thermoelectric powerplants, and about 242,000 tons for heating. NCC reported that lignite reserves, which are found in Thrace and almost everywhere in Anatolia, totaled 5 billion tons. TKI owned 4 billion tons of this reserve and the remainder was distributed among several private producers. Production in the past 16 years was 87.3 million tons, of which TKI produced 68%; the remainder was by the private sector.

In 1976, the future bituminous coal and lignite requirements of Turkey by various sectors of industry were anticipated to be as follows, in thousand tons:

Year	Heating	Electricity	Industry	Communication	Total
Bituminous:					
1976	495	1,034	5,845	650	8,024
1977	495	714	4,707	650	6,566
1978	495	535	4,978	650	6,658
1979	495	535	6,378	650	8,058
1980	495	535	6,978	650	8,658
1992	495	535	6,978	650	8,658
Lignite:					
1976	10,295.0	3,518	3,229.0	--	17,042.0
1977	10,945.0	5,270	3,249.1	--	19,464.1
1978	11,536.0	5,490	3,561.0	--	20,587.0
1979	12,159.0	10,935	3,902.8	--	26,996.8
1980	12,816.5	21,665	4,277.4	--	38,758.9
1992	22,050.4	31,098	12,181.3	--	65,329.7

Petroleum.— Türkiye Petrolleri Anonim Ortakligi (TPAO), a State-owned Turkish petroleum company, prepared for an extensive exploration activity program in 1976. In addition, to meet growing oil product requirements completely from domestic refineries and considering demand forecasts for the coming years, a refinery construction program was prepared. In accordance with this program, Turkey would be able to meet all of its requirements by 1981.

By yearend 1976, TPAO had 6,251 employees. The number of licenses and leases for petroleum and natural gas exploration increased in 1976. The following tabulation shows the number of licenses, by district, as of yearend 1976 compared with that as of yearend 1975:

District	Yearend 1975	Yearend 1976
I:		
Onshore	15	16
Offshore	21	21
II:		
Onshore	13	16
Offshore	8	4
III:		
Onshore	16	16
Offshore	18	18
IV:		
Onshore	15	15
Offshore	31	31
V	14	14
VI	13	14
VII:		
Onshore	8	11
Offshore	4	4
VIII	16	16
IX	24	24
X:		
Onshore	7	7
Offshore	11	11
XI	7	8
Total	241	246

A total of 14.4 million barrels of crude oil, produced by TPAO and other companies, was transported by Turkish pipelines. An additional 227,000 barrels of oil produced at the Thrace fields in northwestern Turkey was transported to Zeytinburnu by tanktruck and from there to TPAO's refinery by tanker.

In 1976, the TPAO refinery at Batman processed 1.0 million tons of crude oil and the one at Izmir processed 3.1 million tons, as follows, in thousand tons:

Product	Batman refinery	Izmir refinery
Liquefied petroleum gas	11	62
Naphtha	35	93
Gasoline	99	389
Solvent	7	--
Kerosine	29	112
Diesel oil	182	887
Fuel oil	464	1,290
Asphalt	201	13
Jet fuel	--	32
Lubricating oils	--	129
Unfinished products, slop	--	69
Total[1]	1,029	3,074

[1] Data may not add to totals shown because of independent rounding.

One of the peculiar characteristics of TPAO was its statutory objective of promotion and implementation of ventures in the national interest. TPAO, as the result of intensive vertical integration, was a shareholder in seven different firms related to refinery, pipeline, or petrochemical ventures. Istanbul Petroleum Refining Company (IPRAS) was established in 1960 with capital of $10 million contributed by TPAO and the Caltex group. Later, TPAO became the sole owner and raised the capital to $15 million. During 1976, IPRAS processed 5.4 million tons of crude oil in its facilities.

Petkim Petrokimya A.S. was established with capital of $25 million in 1965. By vertical integration and new financial arrangements, TPAO held 33% of the shares, and the total capital of Petkim was evaluated at $250 million.

Ipragaz A.S., established in 1966 to deal with distribution of liquefied petroleum gas (LPG), was jointly owned by TPAO (49%) and Eureka Metals Corp. with capital of $1 million. Ipragaz distributed about 159,000 tons of LPG in 1976.

Istanbul Ammonia-Urea Manufacturing Co. was under control of TPAO which owned 60% of the shares. The ammonia-urea plant under construction was expected to produce 1,000 tons per day of ammonia and 1,550 tons per day of urea by mid-1978. Total capital in this company was estimated at $80 million.

Table 5.—Turkey: TPAO drilling activities, 1966–76

Year	Exploration		Confirmation		Development		Injection		Total	
	Number of wells drilled	Depth (meters)	Number of wells drilled	Depth (meters)	Number of wells drilled	Depth (meters)	Number of wells drilled	Depth (meters)	Number of wells drilled	Depth (meters)
1966	15	30.051	7	13.527	30	43.418	--	--	52	86.996
1967	11	18.938	1	3.527	50	69.581	1	1.495	63	93.541
1968	12	26.427	5	8.109	27	38.603	--	--	44	73.139
1969	9	32.836	--	--	25	36.179	--	--	34	69.015
1970	24	40.156	5	7.932	14	26.188	--	--	43	74.276
1971	11	29.384	7	13.404	10	15.525	4	5.362	32	63.675
1972	19	36.113	7	12.917	10	15.894	--	--	36	64.924
1973	25	47.748	24	42.870	1	--	--	--	50	90.618
1974	26	52.941	18	26.605	16	24.392	--	--	60	103.938
1975	42	72.059	5	7.538	19	32.693	--	--	66	112.290
1976	41	70.607	13	22.793	30	42.885	4	5.670	88	141.955

Marine Operations and Transportation Co. was established in 1974 with capital of $5 million to transport petroleum and petroleum products. TPAO held 45% interest in this company in 1976.

Fuel Distribution Co. was established in 1974 with capital of $10 million to market and distribute petroleum products in domestic and foreign markets during 1976. TPAO's share in the firm was reported at 45%.

Petroleum Pipeline Corp., with capital of $50 million and completely owned by TPAO, started functioning in 1974. One of the major undertakings of this company was the construction and supervision of the Iraq-Turkey pipeline in 1976.

Construction of the 1,000-kilometer Iraq-Turkey crude oil pipeline was completed in 1976. It linked the northern oilfields of Iraq near Kirkuk to the Turkish port of Dörtyol on the Mediterranean coast and was to be commissioned early in 1977. The pipeline construction was contracted to Mannesman-Export of West Germany with a subcontract on the Iraqi portion to Banister-Price at a total cost of approximately $450 million. The line had three major river crossings, one of the Khabur River and two of the Tigris River. The pipeline, with an initial capacity of 500,000 barrels per day, provided Iraq with an additional outlet to the Mediterranean. The peak capacity is expected to be up to 700,000 barrels per day. Turkey was to buy 200,000 barrels per day of petroleum in 1977–79, with an option to expand that to 280,000 barrels per day when the pipeline capacity was expanded. Iraq National Oil Company agreed to pay Turkey a transit fee of 35¢ per barrel for a 20-year period, starting with the transmission of crude oil.

Feasibility studies on a 2-billion-cubic-foot-per-day natural gas pipeline to transport Iraqi natural gas to Istanbul were carried on by TPAO planners during the year. No decision or financial details were available by yearend.

A technical and commercial protocol between the Governments of Turkey and Romania pertaining to the implementation of a refinery with a 5- or 10-million-ton-per-year capacity was signed in Ankara in 1976. Construction work started during the latter part of the year at Hacilar village near Kirikkale, central Anatolia. Details on financing of the project, as well as the completion date of construction or the start of production, were not available by yearend.

Exploratory work in the Aegean Sea continued during the year and TPAO planned to drill three wildcat test wells. The dispute between Turkey and Greece over the offshore rights of both countries remained unresolved in 1976, although discussions on the subject continued. Shell Company of Turkey remained the largest foreign operator in Turkey, producing about one-half of the country's total oil output from 66 wells in 14 fields. In 1976, the company drilled five successful oil development wells and four wildcat wells, three of which were dry and one suspended.

Petroleum production averaged 51,000 barrels per day from 385 producing wells in 1976, down a substantial 17% from that of the year before. There were three producing natural gas wells.

The Mineral Industry of the U.S.S.R.[1]

By V. V. Strishkov [2]

The U.S.S.R. maintained its position in 1976 as the world's second largest producer of industrial products. Production schedules are coordinated and production targets predetermined, in principle, by the national plan for economic development. In the U.S.S.R., 1976 marked the first year of the tenth 5-year plan, 1976–80. The following production increases over 1975 figures were reported (in million tons): Raw coal, 10.2; crude oil (including gas condensate), 28.7; iron ore, 6.3; pig iron, 2.5; crude steel, 3.5; finished ferrous rolled metals, 2.7; steel pipe, 0.8; mineral fertilizers (Soviet standard), 2.3; and cement, 1.9. Electrical power output increased 73 billion kilowatt-hours. Output of many nonferrous metals, rare and precious metals, petroleum refinery products, and nonmetallic minerals was also higher than in 1975.

The U.S.S.R. in 1976 was the world's leading producer of iron and manganese ores, platinum-group metals, petroleum, crude steel, potash salts, asbestos, and cement. It occupied second place, following the United States, in world output of aluminum, lead, natural gas, coal, and phosphate rock; it ranked second to Canada in the production of nickel; and it followed the Republic of South Africa in gold and chromium ore production.

Although the U.S.S.R. led in the production of several mineral commodities, how much the country can produce was secondary to the question of how it used what it produced and how effective it was at technological innovation. The structure of the Soviet economic system discourages innovation, which leads to a lack of incentive and a lack of growth.

The growth rate of the Soviet economy during 1976 failed to meet substantially reduced goals in a number of key areas, and gains in industrial output were the lowest since World War II. Reportedly, industrial output increased 4.7% (4.3% planned), and reported national income rose 5.0% (5.4% planned) to 380 billion rubles.[3] Heavy industry output rose 5.5% (4.9% planned), and consumer goods production rose 3.0% (2.7% planned). Capital investment rose to 117 billion rubles at the planned rate of 4%.

Reportedly, the 1976 plan in industrial output was overfulfilled, and its value increased from 509 billion rubles in 1975 to 533 billion rubles in 1976. The level of Soviet industrial production as planned and reported in 1976 is given in the following tabulation, in million tons unless otherwise specified. The Soviet mineral industry is expected to grow over the next decade but at a reduced rate.

Commodity	Production	
	Planned	Reported
Raw steel	147	145
Finished ferrous rolled metals	103	101
Steel pipe	17.0	16.8
Mineral fertilizers (Soviet standard)	94.5	92.3
Raw coal (bituminous, anthracite, lignite)	715	712
Natural gas billion cubic meters	313	321
Crude oil (including gas condensate)	520	519.7
Electrical power billion kilowatt-hours	1,095	1,111

Source: Pravda, Moscow. Jan. 23, 1977, pp. 1–2.

[1] This chapter is based on a review of the sources published by the U.S.S.R.

[2] Physical scientist, International Data and Analysis.

[3] The official exchange rate in December 1976 was 1 ruble=US$1.34. The approximate buying power of 1 ruble in the United States for hard goods and food ranges from about $0.20 to $0.50.

Production of electrical power and natural gas exceeded plan targets; crude oil production, including gas condensate, closely approached the target; and raw coal output fell short of the plan. Production of chemicals and petrochemicals rose 8% over that of 1975 (7% planned), and output in machine-building and metalworking rose 10% (8.6% planned). Slight shortfalls were reported in output of many key industrial products: Raw steel, finished ferrous rolled metals, mineral fertilizers, and steel pipe.

Despite reports of difficulties in crude oil production, the country reached its goal of 519.7 million tons. Virtually the entire increase of 28.7 million tons came from western Siberia, which accounted for about 35% of total Soviet crude oil output in 1976.

Expansion in the mineral industry continued to be achieved mainly through increased use of labor and capital rather than advancing technology. Because of shortages of mineral commodities, efforts directed chiefly toward fulfilling quantitative goals detracted from necessary attention to quality considerations. A considerable part of the industrial output did not meet Soviet standards of quality. Labor turnover remained a serious problem at many mines and plants, particularly in the north and northeast. This was attributed mainly to delays in housing construction schedules, inadequate medical and other public services, low material incentives, and the heavy manual work involved.

A special decree emphasized the importance of eliminating cheating in reported statistics by managers. For example, a construction directorate reported that it had completed a nonexistent road. In another case, a plant that had fulfilled its plan by 69% was able to show by means of "additions" that it had fulfilled the plan 100%.[4]

The Ministry of Ferrous Metallurgy was unable to meet the 1976 plan for production of many types of products. As a result, consumers of these products in construction, transportation, industry, and agriculture did not receive enough of the products required. Insufficient production of high-quality steel of special strength required for items such as aircraft, nuclear reactors, and pipe, and the shortage of many shapes of ferrous rolled products compelled the machine-building industry to use substitute products. This was reflected in the quality of machines and led to excessive use of metal, a significant part of which was wasted as shavings.[5] The U.S.S.R. reported imports of ordinary steel sections, steel pipe, and special steel from Japan and Western countries.

Practically all sectors of the mineral industry maintained a greater number of production personnel than called for by plan targets. According to Soviet trade journals, the ferrous and nonferrous metals industries employed over 3 million workers; the ferrous metals industry alone accounted for about 1.4 million "production" (a Soviet term used in its statistics) workers, 75,000 university graduate engineers, and 125,000 graduate technicians. Soviet newspapers reported that the coal industry employed 2,152,700 men and women, including 1.2 million production workers, some 700,000 nonproduction workers, 215,000 graduate engineers and technicians, and 27,800 managers and general managers. The coal industry employed 770,000 women, including 109,000 at underground mines. There were 638,000 workers in the Donets coal basin alone in 1975.

The oil, gas, and petrochemical industries employed 2.6 million people including over 250,000 in the development of oilfields and gasfields. According to press reports, the crude oil extraction industry employed about 740,000 persons. The standard workweek in the U.S.S.R. is 41 hours.

Expenditures by Soviet scientific and research establishments amounted to 4.8% of the national income and 20% of the annual capital investment. During 1965–73, the expenditure on science and research in the U.S.S.R. increased 80%; in 1970–73 it increased 16.8%, amounting to 7,502 million rubles in 1973.[6] There are 250 scientific and research organizations alone in the Academy of Sciences, employing 160,000 persons in 1975.[7]

There were 132,000 graduate mining engineers in the Soviet economy in 1974. Of these, 34.4% were employed by the coal industry, 10.6% by the ferrous metals industry, 10.4% by the nonferrous metals

[4] Vestnik statistiki (Herald of Statistics), Moscow. No. 9, September 1976, pp. 3–10.
[5] Pravda, Moscow. Sept. 24, 1975, p. 1.
Material'no-tekhnicheskoye snabzheniye (Material-Technical Supply), Moscow. No. 12, December 1976, pp. 52–58.
[6] Effektivnost' nauchnykh issledovaniy (Efficiency of Scientific Research). Ed. by A. Dronov, Minsk, 1975, pp. 182–239.
[7] Pravda, Moscow. Oct. 6, 1975, p. 1.

industry, 4.3% by heavy machine construction, 4.3% by the Ministry of Higher Education and the Academy of Sciences, and 36% by other branches of the national economy.[8]

The productivity of labor and equipment continued to be below planned levels. Press reports and trade journals indicate that more than one-half of the machinery employed in the mining industry was idle, owing largely to the quality of machines and the unsatisfactory supply of spare parts at mines and plants. Much of the equipment used in the Soviet mineral industry is standardized and of a type made earlier in Western Europe and the United States. Production of mining and metallurgical equipment has grown substantially, but the technical standards and quality of equipment are poor. Many plants preferred to manufacture outdated equipment rather than undertake new technology.

At many mines and plants, up to one-half of the production workers were employed in manual labor, including the surface loading and unloading of supplies and equipment. At polymetallic mines in Kazakhstan, the degree of mechanization in mining did not exceed 34%, and most of the auxiliary operations were manual. In underground coal mining, over 50% of the workers were employed in nonmechanized tasks. In 1975, official reports stated that 50% to 65% of the workers were engaged in auxiliary jobs in all branches of the Soviet mineral industry.

Consumption of materials exceeded established norms at many enterprises and construction projects, particularly those for metals, fuels, electrical power, and cement. Stocks of materials and equipment were 50% to 80% higher than necessary. Because of improper storage, equipment, metal, and other mineral products deteriorated and frequently were not suitable for use.[9]

Losses of metals, fuels, and other materials continued to be excessive. According to Soviet sources, the U.S.S.R. used between 25% and 100% more ferrous metals per unit of industrial output than did the United States. For example, oxygen converters with a capacity of 100 tons manufactured by the Zhdanov heavy machine-building plant are 200 tons heavier than similar converters produced by Western firms.[10] Yearly losses of coal in rail transportation were reported at 20 million tons, and additional expenditures for cleaning up coal spills from the railroads, 50 million rubles.

The available losses of mineral commodities are not known completely, nor have they been adequately quantified, but estimates have been reported widely in the Soviet press. A careful study of Soviet publications shows, for example, that only about 45% of the total raw steel production is efficiently used in the Soviet economy; 55% is remelted or lost as a result of low technology.

Although the U.S.S.R. does not publish statistical data on injuries in the mineral industry, available Soviet information and Western mining engineering experience indicate that fatality rates are significant. Official reports state that in the first half of 1976, fatal injuries occurred at 35% of the Soviet coal mines and open pits and 1% of the metallic and nonmetallic mines and open pits. The largest number of accidents have for many years occurred at production and developmental faces as a result of roof collapse. The second largest number of accidents occur during underground haulage, followed by accidents with machines and electrical current accidents. Blasting and handling of explosives accounted for the next largest group of accidents. Accidents caused by roof falls are the result of inadequate support, mainly owing to the shortage of props. Accidents at beneficiation and metallurgical plants have been caused mainly by operating wornout machinery, the low level of equipment repair, and violations of technological processes.[11]

The accumulation of dust at work sites in underground mines and metallurgical plants of the U.S.S.R. is high and often exceeds the industrial health standard. Some mineral industry enterprises are not being adequately equipped with dust and gas treatment facilities, according to published reports. Sanitary facilities, as well as

[8] Izvestiya vysshikh uchebnykh zavedeniy, Seriya gornyy zhurnal (University Herald, Seria Mining Journal), Sverdlovsk. No. 3, March 1976, pp. 3–10.

[9] Pages 63–66 of second work cited in footnote 5.

[10] Ekonomika Sovetskoy Ukrainy (Economics of the Soviet Ukraine), Kiev. No. 9, September 1975, pp. 11–16.

[11] Bezopasnost' truda v promyshlennosti (Labor Safety in Industry), Moscow. No. 9, September 1976, p. 3.
First work cited in footnote 5.
Sotsialisticheskaya industriya (Socialist Industry), Moscow. July 21, 1976, p. 2.

protective outer garments, are few and considerably below the official Soviet standard. There were especially unsatisfactory conditions at the Kuznetsk metallurgical complex, the Chelyabinsk and western Siberian metallurgical plants, the Zhdanov coke plant, the Belov zinc plant, and the enterprises of the Severovostokzoloto (Northeastern Gold) Association and the nonmetallic industry.

Soviet statistical agencies do not publish data on the actual earnings of mineral industry workers, with the exception of highly paid production workers. The average official monthly earnings of Soviet workers and employees in 1976 was 151 rubles, compared with 146 rubles in 1975, an increase of 3.4%. In 1976, the raising of the monthly minimum wage from 60 rubles to 70 rubles continued in the north and the Soviet Far East and in some European regions of the U.S.S.R. The reported average monthly earnings, including all types of bonuses, of selected highly paid production workers are shown in the following tabulation, in rubles:

Sector	1974	1975
Extractive	209.5	219.0
Of which, mining	229.3	239.9
Manufacturing	149.4	155.9
Power engineering	160.2	167.3
Coal	262.0	274.9
Ferrous metallurgy	177.9	188.0
Chemical and petrochemical	159.1	165.2
Machine-building and metalworking	157.5	164.1
Construction materials	159.7	165.4
Glass	148.1	154.1
China	138.4	142.8
Consumer goods	119.1	124.6
Food	140.3	145.9
Average (all industry)	155.5	162.2

Source: Vestnik statistiki (Herald of Statistics), Moscow. No. 8, August 1975, pp. 87–92.

According to Soviet calculations, a minimum family income amounts to between 100 and 150 rubles per person per month,[12] but a Soviet study of wages earned by workers in large cities has shown that the average family income is 50 rubles or less per person. Forty percent of workers' families had a monthly income of 51 to 71 rubles per person, and only about 25% of such families had a monthly income of more than 75 rubles per person. The Soviet study also showed that in smaller towns, the family income per person was even lower than these averages.[13]

The corollary is that most blue-collar workers (and an even larger percentage of white-collar workers, whose average earnings are lower) have a family income that is less than half what is officially regarded as adequate.

The piece-rate principle, previously condemned, has become an important feature of industry. Soviet labor legislation requires that workers achieve a minimum output within a given period. This minimum is the work norm and is established for virtually every phase of employment. In connection with a significant increase in output quotas established during the last 2 years, there was a substantial increase in the proportion of workers who did not meet the increased quotas. For some mineral industry enterprises it amounted to 15% or more in 1975.[14]

Whereas trade unions in Western countries are principally wage-negotiating organizations, their Soviet counterparts function largely as an avenue for increasing labor productivity and fulfillment of planned quotas. The unions operate the insurance systems and also work with management on safety. Practically every worker, including the entire management team, belongs to the union.

About two-thirds of the total tonnage of mineral industry products transported in the U.S.S.R. in 1976 was shipped by rail.[15] The average distance of rail deliveries of ores increased from 689 kilometers in 1970 to 754 kilometers in 1975, and that of ferrous metals increased from 1,360 kilometers to 1,413 kilometers during the same period.

Government Policies and Programs.—Soviet mineral policy continues to be based on the principle of maximum self-sufficiency at all costs. Actual or estimated costs of production are not a prime factor in the selling price of a commodity on the domestic or international market. The Soviet system permits the establishment of selling prices at any level believed desirable to meet political or economic requirements. Therefore, many mineral ventures in the U.S.S.R. would be uneconomic by Western standards.

One of the most striking contrasts be-

[12] Gordon, T. A., and E. V. Klopov. Chelovek posle raboty (Man After Work), Nauka-Press, Moscow. 1972, p. 36.

[13] Page 7 of work cited in footnote 12.

[14] Voprosy ekonomiki (Problems of Economics), Moscow. No. 10, October 1975, p. 9.

[15] Zheleznodorozhnyy transport (Railroad Transportation), Moscow. No. 3, March 1976, p. 35.

tween Soviet and Western mineral economies is the clear direction given to the development of Soviet mineral policy. In most market-oriented economies, national mineral policy is largely an accommodation of often divergent and conflicting sectors of the economy. In contrast, the U.S.S.R.'s 5-year plans and year-to-year plans set a definite policy in unmistakable terms for all mineral commodities. In addition to setting national priorities within which each industry must operate and individual industry goals, the plan is also law and carries mandatory obligations. Mineral development, as the basis for industrial growth, holds a key place in Soviet economic policy. Substantial funds distributed over a dozen specialized ministries are spent on mineral exploration and development.

The State plan for 1977 was ratified by the Supreme Soviet on October 29, 1976. The original target for 1977, which was part of the 1976–80 plan, was reduced, and heavy industry production is to be stressed for the year. Industrial growth is to be 5.6%, compared with the average annual rate of 6.5% projected in the 5-year plan. Heavy industry is to grow 5.9% and consumer goods industries 4.9%. National income is to increase 4.1%, and capital investment is to total 121,500 million rubles, a 3.8% rise over that of 1976. Major investment areas in 1977 will continue to be the fuel energy sector and the ferrous, nonferrous, chemical, and machine construction industries.

Special attention in the 1977 plan (as in the 1976 plan) is to be focused on the fuel and power sector. Generation of electrical power is to be increased; because of the continuing fuel crisis and to improve the fuel energy balance in the European part of the U.S.S.R., impetus will be given in 1977 to the rapid expansion of nuclear powerplants. The planned increase in crude oil extraction (including gas condensate) is to come from western Siberia. The increase in natural gas output is to come from western Siberia, Soviet Central Asia, and Orenburg Oblast. The main increase in raw coal (bituminous, anthracite, and lignite) output is to be from open pit lignite operations in Siberia and Kazakhstan. Increased hard coal production will be from the Donets and Kuznetsk Basins.

Raw steel and pig iron output is to be increased, as is that of finished ferrous rolled metals. It is planned to produce 243.3 million tons of usable (477.5 million tons of crude) iron ore (including 166.6 million tons of concentrate), 158 million tons of sinter agglomerate, 36.4 million tons of pellets, and 10.3 million tons of usable (20.3 million tons of crude) manganese ore in 1977.

Soviet industrial production, in million tons unless otherwise specified, is summarized in the following tabulation:

Commodity	1976		1977
	Planned	Reported	planned
Iron ore	NA	239	243.3
Pig iron	NA	104	110.2
Raw steel	147	145	151.1
Finished ferrous rolled metals	103	101	105.4
Steel pipe	17	16.8	17.6
Raw coal (bituminous, anthracite, lignite)	715	712	733
Crude oil (including gas condensate)	520	519.7	550
Natural gas—billion cubic meters	313	321	342
Mineral fertilizers (Soviet standard)	94.5	92.3	98.5
Cement	NA	124	NA
Electrical power—billion kilowatt-hours	1,095	1,111	1,160

NA Not available.

Relations with CMEA Countries.—Much attention is now being devoted to economic integration and industrial cooperation among the Council for Mutual Economic Assistance (CMEA) [16] countries, and this tends to make Eastern Europe, Mongolia, and Cuba more dependent upon the Soviet mineral industry. The 29th session of the CMEA held in Budapest in June 1975 concentrated primarily on closer integration of economic plans for the 1976–80 period and the specialization of industrial production. The Plan for Multilateral Integration Measures for the CMEA incorporates, among other Soviet projects, joint construction

[16] The CMEA (or Comecon) was founded in January 1949. The founding members were Bulgaria, Czechoslovakia, Hungary, Poland, Romania, and the U.S.S.R. Albania joined in February 1949 but ceased to take part in meetings in 1961. East Germany was admitted in 1950, Mongolia in 1962, and Cuba in 1972. Yugoslavia obtained permanent observer status in 1965.

and financing of the Kiyembay asbestos complex, development of the Orenburg gasfield and the gas pipeline from Orenburg to the western Soviet border, the 750-kilovolt transmission line from Vinnitsa to the Hungarian border, and new facilities for iron ore mining and petroleum refining elsewhere in the U.S.S.R. Reportedly, the total investment in joint projects involves about 9 billion transferable rubles by participating CMEA countries, with provisions for repayment to be made in raw materials produced (asbestos, iron ore, natural gas, petroleum, and electrical power).

In July 1976, the CMEA member countries announced their plan for economic development throughout the next 15 years. The U.S.S.R. is to be Eastern Europe's supplier of mineral raw materials. A Soviet-led CMEA planning committee was to submit a draft report at the 1977 annual meeting.

The following are the principal goals for economic integration over the next 15 years:

The nine CMEA nations regard the coordination of their 5-year plans as a basic element of planned cooperative development and as a principal approach to the main aims of forming a stable economic reciprocity. The countries aim to streamline cooperation in mutual trade, including questions of price formation, and to develop trade with centrally planned economy nations not within the CMEA group. Long-term commercial agreements are to continue, based on the results achieved in the coordination of national economic plans.

The program also calls for joint planning of branches of industry and specialization by each country so as to divide labor more rationally, for cooperation in prospecting, for joint economic forecasting, and for standardization of machine systems, equipment, and instruments.

In the iron and steel industry, special attention is to be devoted to increasing the beneficiation and agglomeration capacity in the U.S.S.R. to insure long-range supplies. The requirements of CMEA members for metallurgical coke are to be met mainly by deliveries from Poland, the U.S.S.R., and Czechoslovakia.

Plans also call for increased production of copper and zinc in the U.S.S.R. These metals will be made available to CMEA members in proportion to their capital investments in the new projects in the U.S.S.R. and Poland. Additional capacities for production and transportation of crude oil and natural gas are to be created in the U.S.S.R. and for coal in Poland, Czechoslovakia, and the U.S.S.R. These countries are indicated as the principal producers and exporters of coal and coke to other members; the U.S.S.R. is the chief supplier of crude oil and natural gas.

The CMEA nations also agreed to integrate their efforts in geological prospecting, construction of mineral projects, joint development of mineral resources, and scientific and technological research.

CMEA member countries are placing great importance on their international banks—the International Investment Bank and the Bank of Economic Cooperation. The former will promote the development of medium- and long-term credit systems for joint enterprises connected with the expansion of economic cooperation among member countries. The activity of the latter, concerned with short-term credits, will be directly involved in insuring the transferability of the collective currency. The introduction of free convertibility of member nation currencies, based on a transferable ruble, has already been implemented.

In certain circumstances, the U.S.S.R. extends credit for the construction of industrial projects under "aid" for the industrialization of CMEA nations, where rich resources of ores and fuels exist. However, the production goes to the U.S.S.R. to offset credits and interest and to pay for services, fuels, and metals that are imported from the U.S.S.R. In this way, the uranium resources of Czechoslovakia and Hungary, the bauxite of Hungary, the nickel of Cuba, the polymetallic ores and concentrates of Bulgaria, the fluorspar, gold, and coppermolybdenum ores of Mongolia, and the coal and zinc of Poland go directly to the U.S.S.R.

In June 1976, for example, Bulgaria signed an agreement with the U.S.S.R. for joint development of the Bulgarian nonferrous metals industry in 1976–80 and beyond. The U.S.S.R. is to aid Bulgaria in the construction and renovation of 14 projects. In September 1976, a new protocol on increasing the activities of Mongolian-Soviet Nonferrous Metals (Mongolsovtsvetmet), a joint economic trust created in 1973, was

signed in Moscow. The protocol calls for the mining of a new fluorspar deposit in Mongolia. Mongolsovtsvetmet is engaged in the mining and processing of various nonferrous metals in different regions of the country, including the Erdenet copper-molybdenum complex.

In 1976, the U.S.S.R. concluded agreements with Poland and Hungary for joint construction of a new broad-gage railroad to link the Soviet frontier with the steel complex under construction at Katowice, Poland, and a petroleum product pipeline to Hungary. Soviet experts are taking part in construction and renovation of some 50 projects in Yugoslavia.

Relations with Developed Countries.—In its economic relations with developed market economy countries, the U.S.S.R. strives for all-around economic cooperation. Long-term agreements on developing economic, scientific, technical, and industrial cooperation were signed in 1974–76 with the United States, West Germany, France, Italy, the United Kingdom, Denmark, Austria, the Netherlands, and Portugal, and with many individual companies in the West. These provide for cooperation in construction of industrial complexes, expansion and modernization of existing industrial enterprises, and research planning.

Soviet law does not permit private ownership of the "means of production." Foreign investors, however, are invited to develop deposits and construct plants in the U.S.S.R., with repayment to be made in some cases in future deliveries of the product of these operations. In other cases, exchanges of other goods or cash payment is arranged. Thus the U.S.S.R. is able to bring much needed investment and technology from Western countries by using "joint" or "compensation" venture arrangements. They provide joint operations in such fields as computer technology and instrument building and in the chemical, ferrous and nonferrous metals, oil, coal, and mineral fertilizer industries. The U.S.S.R.'s announced policy is to expand scientific and technological cooperation with the United States, as Western technology is needed to solve many of the problems in the mineral industry.

Relations with Developing Countries.—The U.S.S.R. encourages State-managed mineral resource development in the developing countries. The U.S.S.R. sends technicians and makes loans to countries willing to promote State development and distribution of fuels and minerals. Soviet technical assistance and economic aid programs include 426 industrial projects in about 70 countries at a cost of some 5 billion rubles. Soviet specialists provide technical assistance for geological research, prospecting, and exploration in 30 developing countries.

In many instances, developing countries repay the U.S.S.R. with mineral commodities. The U.S.S.R. is thus able to secure a significant flow of mineral imports at low cost from friendly developing countries. Indications are that this policy, which results in exclusive access to the resources in question for the U.S.S.R. and other CMEA countries, is to be continued and expanded.

The number of projects built or being built in the developing countries with Soviet assistance (as of January 1, 1976) was as follows, for selected sectors:

Sector	Total under agreement	Already commissioned
Industry:		
Power engineering	74	33
Ferrous and nonferrous metallurgy	38	15
Coal, gas, and oil extraction	37	18
Chemicals, oil refining, petrochemicals	26	13
Mechanical engineering and metalworking	53	40
Construction materials	35	10
Consumer goods and food	149	67
All industry	426	208
Agriculture	138	66
Transportation and communications	88	58
Prospecting for minerals	63	28
Education, culture, health	215	129
Total projects	954	507

Source: Vneshnyaya torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. No. 6, June 1976, pp. 10–11.

A geographical distribution of the industrial projects follows:

Country	Total under agreement	Already commissioned
Asia:		
Afghanistan	38	17
India	46	28
Iraq	51	15
Pakistan	5	1
Sri Lanka	5	4
Syria	12	6
Turkey	10	6
Yemen, People's Democratic Republic of	5	3
Total Asia	278	129
Africa:		
Algeria	31	22
Congo	4	1
Egypt	45	30
Guinea	9	5
Mali	1	1
Somalia	12	5
Sudan	6	6
Total Africa	137	78
Total industrial projects	426	208

Source: Vneshnyaya torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. No. 6, June 1976, pp. 10–11.

The following annual productive capacities, in million tons unless otherwise specified, had been constructed in developing countries with Soviet assistance as of January 1, 1976:[17]

Iron ore	6.70
Pig iron	6.18
Crude steel	4.86
Rolled steel products	2.73
Cement	.10
Raw coal	3.27
Crude oil	40.10
Powerplants ——million kilowatts	4.71

A new management system for the nonferrous metals industry was approved in 1976. The number of independent industrial enterprises decreased from 360 in 1969 to 274 in 1976; the number of small enterprises with up to 600 production workers was reduced by one-third. As a result, enterprises with over 1,200 production workers have over 95% of the total. All-union industrial associations for aluminum, polymetallic ores, copper, nickel, rare metals, gold, secondary nonferrous metals, and others were established.

Although during the past 6 years some progress has been made in reorganizing the management structure of the Soviet economy, the visible results of this effort are so far minimal with regard to output and efficiency.

Transfer of Technology.—Scientific and technical cooperation with developed market economy countries involves the transfer of knowledge and experience in the field of economics and natural sciences and the application of technology and experience to the U.S.S.R. The expansion of scientific and technical cooperation with the Western countries has resulted in the practical application of Western know-how in the U.S.S.R.

Cooperation with regard to the transfer of Western technology is aimed at: (1) Establishing a close link between science and the application of scientific knowledge to production; (2) transfer of Western experience and knowledge through the exchange of specialists in the fields of planning, management, and organization over the entire national economy; (3) transfer of technology, licenses, design and planning materials, standards, instructions, and other documentation; (4) transfer of the acquisition, processing, and use of scientific, technical, and economic data; (5) assistance in the creation and expansion of scientific and technical (research, design, and advisory) centers and in the normal activities of such organizations; (6) training and improvement of the qualifications of specialists in educational institutions, universities, and enterprises; (7) transfer of scientific and technical know-how in the construction, expansion, and commissioning of production enterprises, facilities, and machinery; and (8) promoting the creation and expansion of the scientific and technical potential of the U.S.S.R.

Soviet imports of Western plants and technology related to mineral industry projects fall into the following six major categories:

(1) Extraction, transportation, loading, and refining of crude oil, and construction of petrochemical complexes. Armco Steel Corp. announced that it will provide the U.S.S.R. with offshore oil and gas production technology. In addition, the $30 million agreement involves technology and equipment from Rucker Co. of Oakland, Calif., and Steward & Stevenson Oil Tools Inc. of Houston, Tex. France's Cie. Maritime d'Expertises (COMEX) won a $6 million contract for underwater hardware for offshore oil extraction in the Caspian Sea. West Germany's Blohm & Voss AG received a second 100-million-Deutsche-mark (DM)

[17] Ekonomicheskaya gazeta (Economic Gazette), Moscow. No. 25, June 1976, p. 21.

order for structural-steelmaking equipment, which is to be delivered in 1977–78 to Astrakhan. The equipment will be installed in a plant to be built by the Soviets to produce offshore oil extraction equipment. Brown & Root (U.K.) Ltd., George Wimpey & Co. Ltd., and British Petroleum Co. Ltd. (BP) sold technology for the design and construction of offshore platforms to be used in the Caspian Sea.

Cooper Industries, Inc., of which Cooper Energy Services Co. of the United States is a subsidiary, announced that its British joint venture associate, Coberrow Ltd., has been awarded a $165 million contract for the pump-drive system of a Siberian pipeline similar to the 800-mile Alaskan oil pipeline. Japan's Niigata Engineering Co., Ltd., signed a contract worth 1,900 million yen (Y) for an automated oil-loading installation at the Black Sea port of Novorossisk. Inquiries that could lead to sales of about $1 billion were being made of U.S., Western European, and Japanese manufacturers concerning oil-extracting equipment for the large Samotlor and Fëdorov oilfields.

Reportedly, a French-Soviet agreement worth $1 billion calls for Cie. Française d'Études et de Construction Technip (TECHNIP) to supervise the construction of two identical petrochemical plants at Omsk and Ufa, and to take products of equal value in exchange. Engelhard Industries (France) was presently supplying the U.S.S.R. with catalyst technology for petroleum refining. Soviet engineers were studying the operation of the Montedison S.p.A. petrochemical plant in Italy and were being trained for work at a similar plant now under construction in the U.S.S.R. Soviet plans include the construction of eight major refineries and four auxiliary units in the U.S.S.R., with the assistance of Western firms.

(2) Extraction, transportation, and processing of natural gas. A 100-million-pound (£) contract for gas turbine compressor stations for the 600-mile Siberia-Chelyabinsk gas pipeline was awarded to Cooper Energy Services. The British firm Brown Engineering Co., Inc., and West Germany's AEG-Kanis Turbinefabrik are to deliver compressor station equipment for the Orenburg-West gas pipeline. Other equipment for this gasline was being supplied by West Germany's Gebrueder Windhorst (DM8 million) and Honeywell Austria GmbH ($3.2 million). Fluor Engineering and Construction Inc. will provide design and engineering services to the Japanese steelworks for the supply of equipment for three gas-processing plants for the U.S.S.R.

(3) Coal-mining, heavy earthmoving, and other equipment. The first 10 (of a total of 20) Marion Power Shovel Co. "Super Front" shovels, each with a 26-cubic-yard bucket, have been shipped from Japan, where they were manufactured. The shovels will be used at the Neryungra coalfield in the southern region of Yakutia. The U.S.S.R. also ordered 30 trucks (costing $40 million) from the Canadian subsidiary of Unit Rig & Equipment Co. for southern Yakutia's coalfield. In the future, the U.S.S.R. will need 100 trucks for coal production.

Under an agreement signed in April 1974, Japan is to provide the U.S.S.R. with $450 million worth of coal-mining and railroad equipment for the Neryungra coalfield between 1975 and 1981.

(4) Equipment for the steel industry, including pellet plants, rolling mills, pipemaking equipment, forging complexes, electric furnaces, coating plants, equipment for production of special steels, computer-controlled testing machines, and complete steel plants. Reportedly, Austria's State steel enterprise Vöest-Alpine was negotiating a contract for the construction of a pellet plant in the U.S.S.R. worth over 1 billion schillings (S) ($56 million). Japan's Tanabe Kakoki Co. and Mitsui & Co., Ltd., will supply the U.S.S.R. with six large electric furnaces to be used to smelt ferromanganese. Schloemann Siemag AG, of Düsseldorf and Hilchenbach, West Germany, in consortium with Siemens AG, of Erlangen, West Germany, will deliver the DM257-million cold-rolling mill to the Novo-Lipetsk plant. The plant, with a capacity of 2.5 million tons of strip steel per year for the production of sheet, is scheduled to go into operation in 1979.

A complete plant for the production of powder-based special steel is being supplied by Sweden's Allmänna Svenska Elektriska AB (ASEA) /Stora Kopparbergs Bergslags AB. The £3.4-million plant is scheduled for delivery in 1977.

The French firm Creusot-Loire was negotiating a contract with the U.S.S.R. for a

steel pipe plant worth $300 million. Japan's C. Itoh & Co., Ltd., and Yamamoto Suiatsu Kogyosho Co. signed a Y1,300-million contract with the U.S.S.R. for the supply of 27 hydraulic pipe-bending machines. The U.S.S.R. informally indicated to Japan's companies that it is very much interested in purchasing a plate mill and pipe-making equipment.

Four British companies supplied the Chelyabinsk metallurgical plant with a steel strip-coating plant. A continuous-annealing plant, with an annual capacity of 500,000 tons of coils, is to be supplied to the U.S.S.R. by a Japanese firm. It will form part of the current 5-year plan expansion of the Novo-Lipetsk plant. Schloemann Siemag will supply two complete pickling lines, worth over DM200 million, for the Novo-Lipetsk steelplant.

The British firm Davy-Loewy Ltd. will supply the U.S.S.R. with two forging complexes worth £13.6 million. The United Kingdom's Instron Ltd. signed a contract worth £800,000 to supply computer-controlled material-testing machines and systems to the Leningrad Izhorski plant.

(5) Equipment for the nonferrous metals industry, including heavy earthmoving equipment, beneficiation of polymetallic ores, nickel and copper smelters, titanium dioxide plants, aluminum and alumina plants, and ship-offloading facilities. Equipment valued at over $6 million was being delivered by Suomen Puhallintehdas Ltd. of Finland to the Norilsk copper and nickel plants. Péchiney Ugine Kuhlmann (PUK) is to construct a 1-million-ton-per-year alumina plant at Nikolayev on the Black Sea and a 500,000-ton-per-year aluminum smelter at Sayanogorsk in Siberia. The cost of the alumina plant is over 1 billion francs (F), and that of the aluminum smelter and the associated aluminum fabrication plants is F5 billion. The French company will buy 50,000 tons per year of Soviet aluminum for a 10-year period to pay for the projects. Montedison was negotiating for the supply of a titanium dioxide plant, which will be constructed at Shevchenko in Kazakhstan; Montedison supplied a 20,000-ton-per-year plant at Sumi in the Ukraine in the 1960's.

Poclain S.A. of France signed a contract for F22.7 million for heavy earthmoving equipment for the Siberian nonferrous metals industry. This contract followed Poclain's sale of 15 large cranes to the U.S.S.R. in 1975. Bartles Ltd. is to send 17 Bartles-Mozley wet-gravity separators; this will be the third Soviet order for these concentrators. Ingersoll-Rand Co. of the United States signed a $14 million contract for delivery of 10 large vertical reciprocating pumps; the pumps will be used to transport abrasive polymetallic concentrates through pipelines (presumably at Norilsk). A DM-38-million contract was awarded to Krupp Kranbau of West Germany for the construction of three ship-offloading facilities in 1978. These are to be built at Nikolayev on the Black Sea to offload bauxite for the new alumina plant now under construction by PUK.

A second contract could go to the United Kingdom's Rio Tinto-Zinc Corp. Ltd. for construction of the Udokan copper pilot plant in eastern Siberia. The U.S.S.R. once again proposed to Western firms to consider the establishment of "joint" compensation agreements for development of the Udokan copper deposit.

(6) Ammonia, urea, potash-processing, phosphoric acid, and superphosphate plants and communications systems for ammonia pipelines. The Soviet chemical industry is receiving priority treatment under the 1976–80 plan, with a growth rate of 11%. This growth can only be achieved through major applications of advanced Western technology. The French firms PEC Engineering and Azote et Produits Chimiques are to supply seven identical plants, each producing 1,200 tons per day of P_2O_5 and valued at $72 million. Four of these plants will be constructed in the Ukraine by 1977, two in the European part of the Russian Soviet Federated Socialist Republic (R.S.F.S.R.) by 1979, and one in the Baltic States region. The Norwegian firm Norsk Hydro A/S, with Toyo Engineering Corp. of Japan, is to build five 675,000-ton-per-year fertilizer plants over a 4-year period. The Belgian Coppee-Rust S.A. group received a $135 million order to install four phosphoric acid plants, with a capacity of 1,100 tons per day each. Montedison is to supply equipment for two 450,000-ton-per-year urea plants in 1977 and 1978. A £100,000 contract was given to Doulton Industries U.K. for filtration equipment for fertilizer plants being built at Gorlovka and Odessa in the Ukraine. The Toyo Engineering-Mitsui Group is to supply a $100 million

fertilizer complex, consisting of both ammonia and urea plants, with capacities of 1,300 tons and 1,500 tons per day, respectively. Technimont will supply two 1,500-ton-per-day urea plants, together valued at more than $100 million. The plants are to be built at Kemerovo in Siberia and Berezniki in the Urals.

The U.S.S.R. was negotiating with Japan's Toyo Engineering-Mitsui Group for the purchase of two more ammonia plants, each with a capacity of 1,360 tons per day, at a cost of about $203 million. The U.S.S.R. was also negotiating with Imperial Chemical Industries Ltd. (ICI) of the United Kingdom for the purchase of technology to build an ammonia plant. The U.S.S.R. was planning to build two 100-ton-per-hour potash-processing plants in the Urals with the assistance of Western companies, using Western equipment.

Three French firms will provide a communications system to be installed along the 1,500-mile ammonia pipeline between Togliatti and Odessa. The cost of the system is F50 million.

Western industrial equipment sales to the U.S.S.R. fill gaps the Soviet economic system has not been able to accommodate. Imports of Western technology and highly technical machines and plants assist the U.S.S.R. and its allies in accelerating industrial development.

Exploration.—Over 5,000 deposits of various minerals were being exploited in 1976. Extensive prospecting and exploration for practically all commodities was carried out on a large scale. There were over 500,000 employees in the geological and prospecting organizations of the U.S.S.R. in 1976, including 65,000 graduate specialists with university educations and about 55,000 graduate technicians. A total of about 4 billion rubles was allocated for geological exploration in 1976. About 2 billion rubles was for oil and gas exploration,[18] and some 200 million rubles was for coal exploration. Over 2,500 geological and geophysical teams were permanently employed in prospecting and exploration for oilfields and gasfields, and about 2,200 exploratory wells are completed each year, using some 2,500 drilling rigs.

Construction.—The U.S.S.R. continued to experience difficulty in completing mineral industry projects on schedule owing to deficiencies in planning, inadequate coordination, and equipment and materials shortages. The construction of new projects remained slow and expensive, and material and manpower resources were frequently dispersed over a large number of projects, so that leadtimes were two to three times as long as specified by the U.S.S.R. State Construction Committee. The 10- to 15-year period required to develop a mine with a capacity of 1 million to 2 million tons per year contributed to disparities between capacities of mines, concentration mills, and metallurgical plants in the iron and steel industry, the nonferrous metals industry of Kazakhstan, and many other projects. The practice of resorting to expedients resulted in great inefficiencies and prolonged delays in reaching design capacity. For example, published reports stated that on January 1, 1975, planned capacity goals had not been reached at 12 lead-zinc, 4 copper, 7 aluminum, and 6 nonferrous rolled metals enterprises. At the Achinsk alumina plant, only 53.6% of design capacity was achieved.

Other public statements citing specific shortcomings were numerous. The Rovny nitrogen and Uvarovo chemical plants utilized only 40% to 60% of their capacities. As of January 1, 1976, of fifty 185-meter rotary kilns in operation in the cement industry, thirty-seven did not achieve their design capacity. The planned capacity goals were not achieved at several enterprises of the mineral fertilizers industry. Construction plans of many projects were met according to ruble expenditures, but facilities were not put into operation.

In 1976, the capital construction emphasis was on expansion and renovation of existing enterprises, rather than on new construction. The proliferation of the Zhlobin method (self-accounting construction brigades taking on building contracts of their own free will) was mentioned in all documents pertaining to the 1976–80 plan as a principal means of curing the continuing defects in construction work. However, the number of Zhlobin brigades was growing very slowly, and the shortage of construction materials and equipment continued to affect all but a few brigades. As a result, the average shaft-sinkisg speed of rather small shafts (averaging 5 meters in diameter and

[18] Ekonomika neftyanoy promyshlennosti (Economics of the Petroleum Industry), Moscow. No. 7, July 1976, p. 15.

500 meters deep), for example, was only 15 to 20 meters per month.[19]

Capital investment in the Soviet economy amounted to 117 billion rubles in 1976, 4% over that of 1975, compared with a 9% growth in 1975. The growth rate of commissioning of new capacity fell to 2%.

New enterprises that became operational in the iron and steel industry included a rolling mill at the Kuznetsk steel complex, the pipe-rolling mill at the Severskiy plant, a coke-oven battery at the Avdeyevka works, and new facilities at the Ermakovsk ferroalloy plant, the Karaganda sintering shop, and the Sokolovsk-Sarbaysk iron-mining and processing complex. It was planned to increase capital investment in the iron and steel industry 10.5% over that of 1975.

New capacities for the production of nonferrous metals included the Novo-Berëzovskiy mine at the Irtysh polymetallic complex, the second stage of mine No. 65 at the Dzhezkazgan copper complex, the Koksu mine at the Tekeli lead and zinc complex, and the first stage of the Zhayremsk lead and zinc mine. Additional facilities were installed at the Achisay and Leninogorsk polymetallic complexes, the Ust-Kamenogorsk titanium and magnesium complex, and the Turgay bauxite mine. In 1976, over 2 billion rubles was invested in the development of the nonferrous metals industry, including some 90 million rubles in the development of the secondary nonferrous metals industry. In the mineral fertilizers industry, new capacities included facilities at the Kingisepp phosphorite complex. The first stages of the Armenia nuclear powerplant, with a capacity of 405 megawatts, and the Kursk nuclear plant, with a capacity of 1,000 megawatts, were put into operation in 1976, as was the fourth stage of the Bilibino plant, with a capacity of 12 megawatts.

New production capacity, including new or expanded plants and renovation of existing facilities, was reported for the past several years as follows, in million tons per year unless otherwise specified:

Commodity	1973	1974	1975	1976
Iron ore, crude	39.0	24.4	27.3	45.0
Pig iron	3.7	4.0	1.8	2.25
Raw steel	--	3.0	4.0	1.2
Finished ferrous rolled metals	3.5	1.6	3.3	4.0
Cement	3.7	5.6	4.4	1.85
Mineral fertilizers (Soviet standard)	8.9	7.0	11.7	7.3
Raw coal	34.0	19.4	24.7	12.6
Electrical power million kilowatts	11.0	10.0	13.0	11.9

Total capital investment in the U.S.S.R. for the 1976–80 period was set at 621,400 million rubles, 26% over that of the 1971–75 period, and is to amount each year to the following percentages of the 1975 level: 1975—100%, 1976—105.1%, 1977—108.9%, 1978—112.1%, 1979—114.3%, and 1980—114.6%. According to the 1977 State plan, 121,500 million rubles is to be invested in the Soviet economy in 1977.

Construction of the 3,200-kilometer Baykal Amur Railway (BAM) continued in 1976. There were 58,000 people working on the Railway, including some military workers. The completion date is currently set for 1982. So far, 600 kilometers has been completed.

PRODUCTION

A Soviet decree of April 1956 classifies all data on production capacity and production plans of nonferrous, precious, and rare metals and some nonmetallic enterprises as State secrets. Although the U.S.S.R. does not publish official statistics on many mineral commodities, information is available on most minerals. Published information on industrial development, however, provides some basis for estimating output of many other commodities. The increase in Soviet mineral production in 1976 was largely owing to additional capacity and labor rather than to productivity gains. The U.S.S.R. devotes one-fourth of its gross national product (GNP) to investment, compared with one-sixth in the United States. Total Soviet industrial production remains about one-half that of the United States.

During 1971–75, reported production of nonferrous metals in the U.S.S.R. increased 34.7%; aluminum, nickel, titanium, and hard alloys 50%; copper 30%; rare metals 190%; and semiconductor metals 270%. Output of sulfuric acid at nonferrous operations reached almost 5 million tons, or 25% of the total national production. The

[19] Shakhtnoye stroitel'stvo (Mine Development), Moscow. No. 8, August 1976, pp. 15–16.

working capital at the enterprises of the nonferrous metals industry amounted to 5 billion rubles in 1976.

The Asian part of the U.S.S.R. (east of the Ural Mountains) provided about 45% of total Soviet coal and lignite output, more than 35% of the natural gas, over 33% of the crude oil, and over 30% of the electrical power. The R.S.F.S.R. continued to rank first among the 15 Soviet republics in mineral production. It produced over 80% of the gold and silver, practically all of the platinum-group metals, more than 80% of the petroleum, about two-thirds of the phosphate ores and the electrical power, over half of the pig iron, steel, and ferrous rolled products, and roughly half of the coal and natural gas. The Ukraine continued to rank first in output of coking coal, manganese ore, and iron ore, and second in natural gas.

The Asian Republic of Kazakhstan, one of the most important base-metal-producing areas in the U.S.S.R., occupied third place in Soviet mineral production and was the nation's leading producer of chromite, copper, lead, zinc, and rare metals. During 1971–75, Kazakhstan's production of copper ore increased 21.5%, lead-zinc ore 14.2%, refined copper 40.6%, refined lead 14%, titanium 41%, alumina 23.7%, and sulfuric acid 52.4%. The Urals produced over 30% of the Soviet pig iron in 1976, about 40% of the steel and steel pipe, and about 50% of the potassium fertilizers. The Ural-Volga region produced nearly one-half of the nation's crude oil. Most of the U.S.S.R.'s increased petroleum production was, however, derived from the western Siberian fields.

Production facilities at the Balkhash and Dzhezkazgan copper complexes continued to experience ore shortages and losses owing to unsatisfactory ore reserve estimates at the Kounrad, Sayak, and Dzhezkazgan mines, according to published reports. The slow development of new mines resulted from disparities between mine, mill, and metallurgical plant capacities, particularly in Kazakhstan. The losses of ore at the Kazakhstan nonferrous mines were high. At the underground mines of the Dzhezkazgan mining and metallurgical copper complex, the losses of ore increased from 20.6% in 1970 to 27.5% in 1975. The same is true for the Achisay and Tekeli polymetallic complexes, the Zolotushinsk polymetallic mine, and the Turgay bauxite open pits. The engineering plans at the mines were frequently not followed, and selective mining of rich sections was practiced, according to press reports.

The U.S.S.R. has been increasing production of metals and fuels from year to year, but the economy has been experiencing chronic shortages of coal and ferrous and nonferrous rolled metals. Although many minerals are mined and processed in the U.S.S.R., insufficient attention is being paid to the comprehensive use of mineral resources. During the last 5-year plan, there was a slight increase in extraction from ores into concentrate, but publications maintain that planned extraction targets for many nonferrous metals were not achieved and continued to be much below the Western level. At some beneficiation plants, recovery of gold, silver, and copper from ores in concentrates has even decreased. At the Dzhezkazgan complex, only 48% of the total value of metals was recovered from the ore in concentrate in 1976. It was reported that because of a shortage of reagents, 80% to 90% of rare metals was lost in the tailings at the beneficiation plants at Dzhezkazgan. For example, recovery of rhenium at this complex amounted to only 10% to 12%. Academic mining institutions report that the low recovery of metals by copper-producing plants in the Urals resulted in losses of thousands of tons of copper, zinc, and other nonferrous metals and of large quantities of gold and silver.

Many enterprises, such as the Balkhash and Dzhezkazgan copper mining and metallurgical complexes, the Irtysh polymetallic complex, and the Tekeli lead and zinc complex in Kazakhstan, regularly do not fulfill the plan for labor productivity. Although the mechanization of production has increased, labor productivity at 14 of the 30 underground mines in Kazakhstan decreased during the past 3 years.

At the open pits of the Kadzharan and Agarak copper-molybdenum complex and the Madneuli copper complex, the utilization of drilling rigs did not exceed 20% to 30%. The utilization of excavators at the same open pits in the nonferrous metals industry was only 36% to 40%. It was reported that the utilization of dump trucks was low at the Kadzharan, Tyrny-Auz, and Madneuli nonferrous complexes. The Adrosmansk, Koytash, Chorukh-Dayronsk, and

Akchatausk nonferrous concentration plants operated with large interruptions, and their equipment utilization did not exceed 80%. At the iron ore mines of the Krivoy Rog Basin, published reports show the utilization of machinery in 1976 as follows: Underground mines—electric locomotives 30% to 60%, loading machines 27% to 35%, and drilling rigs 40% to 50%; and open pits—excavators 35% to 55%, rotary excavators 25% to 65%, drilling rigs 37% to 45%, and locomotives 55% to 65%.

The 1976 planned production goals were not met by many mineral industry enterprises. Poor performance was reported, for example, at the Kazzoloto (Kazakhstan Gold) Association, the Balkhash, Leninogorsk, Akchatausk, and Irtysh polymetallic complexes, and other enterprises of Kazakhstan.

Many projects have operated over a long period with lower capacities than originally planned. Only 75% of new projects achieve rated capacity. For example, on January 1, 1975, planned capacity goals had not been reached at 12 lead-zinc, 4 copper, 7 aluminum, and 6 nonferrous rolled metals enterprises. Only 53.6% of design capacity was achieved at the Achinsk alumina plant; 67% of design capacity of the oxygen converter at the Karaganda metallurgical complex was achieved.

The Soviets are increasingly conscious of the age and obsolescence of their mining and metallurgical equipment. Industries continue to produce obsolete models; because of the emphasis on production, no time can be taken for retooling. There is resistance to the use of new and untried equipment with its inherent risk of failure, and the inclination is to use the old but safe and familiar equipment.

Soviet reports also have documented obsolete equipment in 30 cement plants, 43 blast furnaces, 80 open-hearth furnaces, 97 rolling mills, about one-half of the power units, and a large percentage of the metal products plants. Of the 200 coking batteries in the U.S.S.R., more than one-half have been operating for more than 20 years, some of them for 40 years, according to official publications. Many became obsolete or were worn out long ago.

Because of a shortage of some needed equipment, there was a rapid increase in stocks at many establishments. At the beginning of 1976, above-plan uninstalled equipment constituted 36% of equipment as a whole. Much the same applies to equipment bought abroad. During the past 5 years, the value of uninstalled imported equipment increased to 2,100 million rubles. At the same time, many other projects could not be completed because of shortages of equipment.

In many sectors of the Soviet economy, more electrical power, fuels, and metals are consumed per unit of product than required with modern technology. For example, in 1975, this overconsumption of materials was valued at 5.3 million rubles at enterprises in the copper industry, 4 million rubles in the aluminum industry, and 1.5 million rubles each in the lead-zinc and nickel-cobalt industries. In many Soviet industrial enterprises, enormous quantities of secondary power, fuels, and metals are insufficiently utilized.

Table 1.—U.S.S.R.: Estimated [1] production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum:			
Ore and concentrate:			
Bauxite, 26% to 52% alumina	4,300	4,400	4,500
Nepheline concentrate, 25% to 30% alumina	r 3,000	r 3,400	3,500
Alunite ore, 16% to 18% alumina	r 500	r 600	600
Alumina	r 2,300	r 2,400	2,500
Metal, smelter:			
Primary	1,430	1,530	1,600
Secondary	140	150	150
Antimony, mine output, metal content ——tons	7,300	7,500	7,700
Arsenic, white (As_2O_3) ——do	7,300	7,350	7,400
Beryllium, beryl, cobbed, 10% to 12% BeO ——do	1,500	1,600	1,650
Bismuth, mine output, metal content ——do	60	60	60
Cadmium, smelter ——do	2,600	2,650	2,700
Chromium, chromite ore, 30% to 56% Cr_2O_3	1,950	2,080	2,120
Cobalt:			
Mine output, metal content ——tons	1,750	1,800	1,800
Smelter ——do	1,750	1,800	1,800
Copper:			
Ore:			
Gross weight, 0.5% to 2% Cu	74,000	76,500	80,000
Metal content, recoverable	740	765	800
Blister:			
Primary	740	765	800
Secondary	160	160	165
Refined:			
Primary	705	r 725	760
Secondary	160	160	160
Gold, mine output, metal content ——thousand troy ounces	7,300	7,500	7,700
Iron and steel: [2]			
Iron ore, 55% to 63% Fe	224,883	232,803	239,109
Agglomerated products:			
Sinter	148,796	151,943	153,251
Pellets	23,417	27,209	31,398
Pig iron and ferroalloys: [3]			
Pig iron for steelmaking	90,167	93,803	96,033
Foundry pig iron	8,709	8,156	8,398
Spiegeleisen	107	104	102
Ferromanganese	859	878	823
Other blast-furnace ferroalloys	26	27	28
Total	99,868	102,968	105,384
Crude steel: [3]			
Ingots	127,248	132,278	135,684
Steel for castings	8,958	9,047	9,121
Total	136,206	141,325	144,805
Semimanufactures:			
Sections	36,814	37,680	38,084
Wire rod	8,073	8,283	8,348
Pipe stock	5,394	5,624	5,872
Tubes from ingots	1,652	1,656	1,688
Plates and sheets:			
Over 5 millimeters thick	12,295	12,933	13,640
Other	16,714	18,111	18,929
Total	29,009	31,044	32,569
Strip	9,337	10,072	10,603
Railroad track material	3,703	3,816	3,945
Wheels, tires, axles	1,059	1,124	1,190
Unspecified shapes for sale	779	912	745
Other and unspecified	65	73	69
Total semimanufactures	95,885	100,284	103,113
Selected end products: [4]			
Pipes and tubes:			
Welded	8,735	9,499	10,067
Seamless	6,224	6,464	6,738
Total	14,959	15,963	16,805
Cold-rolled sheet	6,492	6,809	6,943
Tinplate	613	613	[3] 612
Galvanized sheet	638	680	[3] 660
Electrical sheet	1,111	1,124	1,151
Cold-reduced strip	352	398	435
Wire, plain	3,724	3,818	[3] 3,850

See footnotes at end of table.

Table 1.—U.S.S.R.: Estimated [1] production of mineral commodities—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS—Continued			
Lead:			
Mine output, recoverable metal content	r 450	r 450	470
Smelter:			
Primary	475	480	500
Secondary	95	95	100
Magnesium metal, including secondary	60	r 60	63
Manganese ore, gross weight [5]	r 8,155	8,200	8,200
Mercury metal, including secondary 76-pound flasks	54,000	55,000	56,000
Molybdenum, mine output, metal content tons	8,800	9,060	9,350
Nickel:			
Mine output, metal content	r 145	r 152	160
Smelter	145	152	160
Platinum-group metals, mine output, metal content thousand troy ounces	2,500	2,650	2,800
Silver metal, including secondary do	42,000	43,000	44,000
Tin:			
Mine output, recoverable metal content tons	29,500	30,000	31,000
Smelter:			
Primary do	29,500	30,000	31,000
Secondary do	10,000	10,000	11,000
Titanium metal do	28,000	30,000	32,000
Tungsten concentrate, W content do	7,600	7,800	8,000
Vanadium do	8,000	8,000	8,000
Zinc:			
Mine output, recoverable metal content	680	690	720
Metal:			
Primary	680	690	720
Secondary	75	75	80
NONMETALS			
Asbestos	1,360	1,900	2,290
Barite	330	350	400
Boron minerals and compounds, B_2O_3 content	80	80	90
Cement, hydraulic [6]	115,140	122,040	123,960
Clays, kaolin (including china clay)	2,100	2,200	2,200
Corundum, natural tons	7,000	7,500	7,500
Diamond:			
Gem thousand carats	1,900	1,950	2,000
Industrial do	7,600	7,750	7,900
Total do	9,500	9,700	9,900
Diatomite	400	410	420
Feldspar	275	280	280
Fertilizer materials:			
Crude:			
Nitrogenous, N content	[5] 7,856	r 8,535	8,150
Phosphatic:			
Apatite:			
Ore, 17.7% P_2O_5	35,600	35,600	37,000
Concentrate, 39.4% P_2O_5	15,300	15,300	15,900
Sedimentary rock:			
Ore, 13% P_2O_5	r 27,000	r 30,000	34,000
Concentrate, 19% to 25% P_2O_5	r 13,500	r 15,000	17,000
Potassic: Potash, K_2O equivalent	[5] 6,586	r 7,944	8,500
Manufactured:			
Nitrogenous	[5] 38,308	41,628	41,970
Phosphatic:			
Meal, gross weight	[5] 5,442	5,573	4,372
Other, gross weight	[5] 20,863	18,243	21,472
Potassic, gross weight	[5] 15,832	19,097	19,977
Total	80,445	84,541	87,791
Fluorspar	450	475	490
Graphite	90	90	95
Gypsum	4,700	5,000	5,000
Lime, dead-burned	22,000	23,000	23,000
Magnesite:			
Crude	3,500	3,600	3,600
Marketable product	r 1,750	1,800	1,800
Mica	41	42	43
Pyrite:			
Gross weight	r 7,700	7,900	8,100
S content	3,600	3,700	3,800

See footnotes at end of table.

Table 1.—U.S.S.R.: Estimated [1] production of mineral commodities—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS—Continued			
Refractory materials:			
Dinas (quartzite-lime)	[5] 632	NA	NA
Magnesite and chrome magnesite	[5] 1,718	NA	NA
Magnesite powder	[5] 1,385	NA	NA
Shamotte	[5] 6,425	NA	NA
Total	r [5] 10,160	NA	NA
Salt, all types	[5] 13,400	r 13,700	14,000
Sulfur, elemental (excluding S content of pyrite):			
From ores	2,400	2,500	2,500
Byproduct recovered	1,900	2,000	2,000
Talc	410	420	440
MINERAL FUELS AND RELATED MATERIALS			
Coal: [7]			
Anthracite [5]	75,828	76,965	77,739
Bituminous:			
Coking	[5] 175,535	r 460,682	470,279
Other (not specifically identified)	[5] 272,000		
Total "hard" coal [5]	523,363	537,647	548,018
Lignite and brown [5]	160,641	163,633	163,504
Coke, coke-oven, beehive, breeze, and gas [8]	82,641	83,543	84,400
Fuel briquets: [8]			
From anthracite and bituminous coal	1,363	1,350	1,350
From lignite and brown coal	6,945	6,987	7,204
Total	8,308	8,337	8,554
Gas, natural:			
Gross ---million cubic feet	9,700,000	10,760,000	11,950,000
Marketed [5] ---do	9,201,299	10,205,890	11,334,295
Oil shale	33,266	32,500	33,000
Peat:			
Agricultural use	131,600	131,600	131,600
Fuel use	60,000	60,000	60,000
Petroleum:			
Crude:			
As reported (gravimetric units) [5]	458,948	491,000	519,700
Converted (volumetric units) --thousand 42-gallon barrels	3,373,268	3,608,850	3,822,000
Refinery products [9 10]	r 351,652	372,649	383,190

p Preliminary. r Revised. NA Not available.

[1] Except where a source is given.

[3] United Nations. Annual Bulletin of Steel Statistics for Europe, 1977, New York. V. 5, 1978, p. 21.

[3] Estimates for 1976 are based upon reported results for the first 6 months of 1976.

[4] Items reported under this heading are produced from semimanufactures listed above and possibly also from similar imported semimanufactures. Therefore, these data are not additive to total semimanufactures as given.

[5] Reported in Soviet sources.

[6] United Nations. Monthly Bulletin of Statistics, New York. V. 32, No. 12, 1978, p. 75.

[7] Run-of-mine coal; the average ash content of coal shipped from mines was 20.2%, and the average calorific value was slightly over 5,000 kilocalories per kilogram (9,000 Btu per pound) in 1976.

[8] United Nations. World Energy Supplies 1972–1976, New York. Statistical Papers, ser. J, No. 21, 1978, p. 57.

[9] Not distributed by type and therefore not suitable for conversion to volumetric units. Data include all energy products and some nonenergy products, as well as refinery fuel, and exclude petrochemical feedstocks, paraffin, petroleum coke, white spirit, unspecified minor nonenergy products, and refinery losses.

[10] United Nations. World Energy Supplies 1972–1976, New York. Statistical Papers, ser. J. No. 21, 1978, p. 80.

TRADE

Foreign trade is within the State monopoly and is administered by the Foreign Trade Ministry, operating through more than 60 foreign trade organizations. Political objectives exert a strong, and often determining, influence on foreign trade. The U.S.S.R. trades with 115 countries, and in 91 cases the trade is based on inter-State agreements. Trade continues to be oriented toward imports of large quantities of Western industrial machinery and technology (including complete industrial plants) and substantial grain purchases. The Soviets rely heavily on both foreign-government-backed and commercial credits to finance the increasing foreign currency deficit. Exports of minerals help pay for these imports.

In the Soviet mineral economy, international trade is given high priority. Since the value and volume of trade are both outlined in the national plans, foreign trade reflects national goals and priorities. There is, therefore, an implied commitment to export to achieve a desired trade balance. The high priority placed upon achieving the goals can result in sales below world commodity prices. Domestic consumer demand is a less important motivation than fulfilling export quotas. Almost all Soviet exports could easily be consumed domestically.

In the overall economy, foreign trade is relatively less important to the U.S.S.R. than to many other industrialized nations. However, definite political and economic objectives are sought through trade, and the U.S.S.R. intends to expand the volume of trade. In terms of foreign policy, the dependence of some countries upon Soviet trade gives the U.S.S.R. varying degrees of economic influence. Sales and purchases in appropriate places enable the U.S.S.R. to exert political pressure. Because the U.S.S.R. has a dominant position in the CMEA, the total volume of trade it influences is significantly greater than the trade volume of the U.S.S.R. alone.

The U.S.S.R.'s exports of fuels, metals, and energy permit a controlling influence over the economies of its CMEA satellites. In Eastern Europe, this control rests largely on the fuels and energy trade. Romania is the only country producing moderate quantities of oil; all others are heavily dependent upon liquid fuel imports. The U.S.S.R. has a controlling influence over the metallurgical industries of the CMEA nations through exports of coke and ferrous and nonferrous metals.

Official Soviet foreign trade turnover (exports plus imports) in 1976 reached 56,784 million rubles, an increase for the year of 6,080 million rubles or 12%. The increase mainly reflected higher prices. Official exports increased by 3,989 million rubles to 28,022 million rubles. Official imports increased by 2,092 million rubles to 28,762 million rubles. Soviet trade turnover with centrally planned economy countries amounted to 31,557 million rubles (about 56% of total trade), of which 28,825 million rubles (about 51% of total trade) was with CMEA nations; trade with developed Western countries amounted to 18,661 million rubles (33%); and trade with developing countries amounted to 6,567 million rubles (over 11%).

The value of official trade with leading developed market economy countries, in million rubles, follows:

Country	1972	1973	1974	1975	1976
Germany, West	827	1,210	2,209	r 2,777	3,013
United States	538	1,161	742	r 1,599	2,202
Finland	602	777	1,540	r 1,755	1,979
Italy	468	614	1,137	r 1,427	1,773
France	544	722	941	r 1,296	1,697
United Kingdom	558	715	890	r 959	1,232
Japan	816	994	1,683	r 1,922	1,131
Netherlands	222	356	571	451	540

r Revised.

Soviet figures for foreign trade in 1976 highlight the declining importance of centrally planned economy countries in the U.S.S.R.'s external trade. Whereas trade with centrally planned economy countries in 1971 represented 65.4% of the total, it was only 58.5% in 1973 and about 56% in 1976. Trade with CMEA countries declined from 59.6% of the total in 1972 to about 51% in 1976.

Official Soviet trade turnover with CMEA countries, in million rubles, was distributed as follows:

Country	1972	1973	1974	1975	1976
Germany, East	3,705	3,965	4,315	5,623	5,997
Poland	2,803	3,000	3,584	4,853	5,235
Czechoslovakia	2,626	2,760	3,029	3,911	4,545
Bulgaria	2,345	2,555	2,904	3,991	4,465
Hungary	1,882	2,064	2,282	3,274	3,492
Cuba	822	1,110	1,642	2,589	2,875
Romania	1,053	1,130	1,191	1,526	1,600
Mongolia	287	338	404	480	614

Official trade with Yugoslavia increased from 569 million rubles in 1972 to 1,821 million rubles in 1976. Trade with Vietnam was 296 million rubles (up from 180 million rubles in 1973); with North Korea, 300 million rubles (down from 357 million rubles in 1973); and with the People's Republic of China, 314 million rubles (up from 201 million rubles in 1973).

The U.S.S.R. has trade agreements with more than 70 developing countries. The official trade turnover with leading nations, in million rubles, follows:

Country	1973	1974	1975	1976
Iraq	332	453	r 600	715
India	589	615	r 686	647
Egypt	541	728	710	531
Brazil	126	202	396	446
Iran	275	496	510	445
Syria	119	172	168	235
Argentina	77	137	304	231
Algeria	117	172	247	190
Nigeria	40	92	108	50

r Revised.

Most of the U.S.S.R.'s 1976 export trade in minerals was with Europe (particularly West Germany) and Japan. Quantitatively, there was no significant change in the patterns of Soviet mineral trade in 1976 from those of 1975. Fuels, metals, and mineral raw materials continued to play the major part in exports, representing about 40% of the official total during 1976. Along with gold, platinum-group metals, chrome ore, manganese ore, aluminum, zinc, lead, asbestos, apatite concentrates, potassium, cement, pig iron, ferroalloys, steel, coal, petroleum, and coke, the country now exports diamond, titanium, nickel, copper, rare metals, and natural gas.

The U.S.S.R. provides nearly 100% of the CMEA countries' imports of crude oil, natural gas, pig iron, and electrical power, two-thirds of their petroleum products, ferrous rolled metals, and phosphorous fertilizers, 60% of their coal and manganese ore, and up to 90% of their iron ore. Exports of Soviet petroleum to CMEA members rose from 138 million tons during the 1966–70 period to some 243 million tons in 1971–75. In 1976–80, the U.S.S.R. is to increase fuel supplies to CMEA countries 43% over the amount supplied during the previous 5-year plan. However, a significant portion of this fuel is required by the CMEA countries to meet their commitments for Soviet industrial orders. The economies of the CMEA countries have been largely reoriented in the direction of the U.S.S.R. Relations among CMEA countries entered a new phase in 1975 when the U.S.S.R. raised oil prices on exports to Eastern Europe an average 130%.

Hitherto, most of the Soviet mineral trade has been with centrally planned economy countries, but the U.S.S.R. is now aiming increased exports to Western countries and especially to the United States. Deliveries of natural gas and petroleum to Western countries are to be increased in the future and are to become an important factor in Soviet exports to Western Europe, largely under 20-year trade agreements. In return, the U.S.S.R. is to receive equipment, pipe, and materials for the development of gasfields and the construction of gas pipelines. The U.S.S.R. provides natural gas to Austria, Italy, Finland, and West Germany, and in January 1976, exports of natural gas to France began.

Mineral commodity imports in 1976 included ferrous semimanufactures, nonferrous ores, concentrates, and semimanufactures, steel pipe, bauxite and alumina, tin, tungsten concentrates, talc, and mica. Soviet petroleum imports come mainly from the Middle East and northern Africa. Natural gas is imported from Iran and Afghanistan.

Table 2.—U.S.S.R.: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal:			
Unwrought	528,713	502,365	East Germany 114,454; Hungary 101,482; Czechoslovakia 90,316; Japan 42,948.
Semimanufactures, rolled only	r 116,318	101,510	Poland 23,587; Bulgaria 9,931; Cuba 7,719; Czechoslovakia 7,373.
Cadmium, unwrought	925	635	Netherlands 210; East Germany 208.
Chromium, chromite ore and concentrate thousand tons	1,139	1,171	United States 270; West Germany 156; Sweden 140; Czechoslovakia 131; Poland 109.
Copper:			
Copper sulfate	20,776	20,361	Bulgaria 7,881; Hungary 4,520.
Metal:			
Unwrought:			
Unalloyed	247,978	205,618	Czechoslovakia 38,746; Netherlands 35,224; Hungary 33,121; West Germany 12,481.
Alloyed	3,747	4,241	West Germany 2,787; Netherlands 786.
Semimanufactures, rolled only:			
Unalloyed	8,885	9,215	Cuba 3,346; Bulgaria 2,773; Poland 575.
Alloyed	9,625	8,468	Bulgaria 1,339; Cuba 506.
Iron and steel:			
Iron ore thousand tons	43,267	43,626	Czechoslovakia 12,236; Poland 11,111; Romania 6,288; Hungary 4,011.
Scrap do	1,465	1,139	Italy 278; East Germany 221; Yugoslavia 169; Japan 131.
Pig iron do	4,910	4,729	Poland 1,502; Czechoslovakia 1,001; East Germany 806; Romania 385.
Ferroalloys:			
Ferrochromium	46,430	44,601	NA.
Ferromanganese	118,298	129,188	
Ferrosilicon	151,420	154,492	
Ferrovanadium	1,623	1,427	
Silicochrome [1]	2,966	1,128	
Silicomanganese [1]	10,688	11,316	
Other (unspecified)	54,380	54,715	
Total [2]	385,805	396,867	Czechoslovakia 113,068; Romania 91,806; Hungary 47,143; Luxembourg 27,742.
Steel ingots and other primary forms thousand tons	1,727	2,170	Bulgaria 939; Romania 271; Hungary 214; Yugoslavia 160.
Semimanufactures:			
Angles, shapes, sections do	1,681	1,551	East Germany 405; Bulgaria 324; Poland 159; Hungary 150; Yugoslavia 80.
Wire rod do	535	418	East Germany 146; Hungary 84; Poland 72; Romania 23.
Plate do	1,827	1,863	East Germany 1,214; Bulgaria 149; Hungary 138; Czechoslovakia 120.
Sheet:			
Tinplate do	59	61	Cuba 25; East Germany 17; Syria 4.
Other do	899	950	East Germany 551; Poland 145; Hungary 93; Bulgaria 51.
Strip do	8	9	Romania 3; Yugoslavia 3; Bulgaria 2.
Railroad track material do	375	371	East Germany 178; Poland 99; Bulgaria 44.
Wheels, tires, axles do	50	52	East Germany 25; Poland 24.
Pipes, tubes, fittings do	322	339	East Germany 207; Cuba 46; Bulgaria 15.
Wire do	77	63	Cuba 22; East Germany 15; Bulgaria 6.
Undistributed by type do	30	35	NA.
Total do	5,863	5,712	

See footnotes at end of table.

Table 2.—U.S.S.R.: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Lead metal, unwrought	95,513	98,889	East Germany 47,009; Czechoslovakia 24,919; Hungary 10,721.
Magnesium metal, unwrought	27,884	11,380	East Germany 2,030; Netherlands 1,701; West Germany 1,503.
Manganese:			
Ore and concentrate:			
Metallurgical grade—thousand tons	1,482	1,411	Poland 484; Czechoslovakia 341; East Germany 179; Bulgaria 126.
Battery and chemical grade—do	[1] 1	NA	
Metal	6	NA	
Vanadium slag	r 36,602	20,598	NA.
Zinc metal, unwrought	114,811	100,575	East Germany 40,553; Czechoslovakia 21,848; India 13,420.
Other (unspecified):			
Unwrought	64,122	43,176	NA.
Semimanufactures	7,384	7,037	NA.
NONMETALS			
Abrasives, hard alloys	167	82	Romania 32; Bulgaria 18; Poland 17.
Asbestos	527,971	613,303	Poland 76,179; Japan 68,334; France 63,160; Poland 59,430; Romania 34,327.
Cement, hydraulic—thousand tons	3,593	3,322	Hungary 722; Poland 622; Czechoslovakia 436; Libya 376; Nigeria 247.
Clays and clay products:			
Refractory clays and baked slate [1]	56,382	70,341	Poland 62,738; Hungary 7,603.
Refractory products, including magnesite products	146,175	126,714	Bulgaria 29,583; Cuba 23,304; Romania 23,282.
Fertilizer materials:			
Crude, phosphatic:			
Apatite ore [1]—thousand tons	22	26	All to East Germany.
Apatite concentrate—do	6,995	5,830	East Germany 1,247; Poland 815; West Germany 622; Hungary 609; Bulgaria 432.
Manufactured:			
Nitrogenous:			
Ammonia—do	96	88	France 23; Poland 22; Cuba 13.
Urea—do	540	499	India 215; United States 116; Iran 62; Cuba 40.
Other—do	980	812	Cuba 246; Czechoslovakia 223; Hungary 104.
Phosphatic—do	518	530	Bulgaria 192; Hungary 138; Cuba 132.
Potassic salts—do	5,580	5,986	Poland 2,467; Hungary 830; Belgium 692; Czechoslovakia 450; Japan 416.
Fluorspar and related materials: Cryolite [1]	1,028	1,041	All to Hungary.
Gypsum [1]	67,866	65,682	All to Finland.
Salt	346,302	320,704	Czechoslovakia 111,308; Hungary 90,844; Finland 58,370.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	31,669	39,274	Cuba 30,240; Vietnam 5,583.
Soda ash	54,996	62,776	Czechoslovakia 17,296; Cuba 10,293; Iran 6,578.
Sulfur and pyrite:			
Pyrite, gross weight—thousand tons	1,796	1,260	Italy 300; West Germany 236; East Germany 118; Yugoslavia 98.
Sulfur, elemental	439,649	440,978	Czechoslovakia 172,112; Cuba 125,520; Hungary 83,960.
Sulfuric acid	161,518	121,054	Czechoslovakia 111,699.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	80,308	86,635	East Germany 23,605; Bulgaria 22,506; Czechoslovakia 18,414.
Coal:			
Anthracite—thousand tons	4,611	4,511	Bulgaria 2,108; France 1,106; Czechoslovakia 328.
Bituminous—do	21,398	21,440	East Germany 3,863; Bulgaria 3,794; Japan 3,303; Czechoslovakia 2,492; Yugoslavia 1,192.

See footnotes at end of table.

Table 2.—U.S.S.R.: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Coke ----------thousand tons--	4,633	4,208	East Germany 1,076; Romania 999; Hungary 741; Finland 608.
Gas, natural ----------million cubic feet--	495,780	672,141	Czechoslovakia 130,452; East Germany 116,608; West Germany 109,369; Poland 88,604; Italy 82,707.
Petroleum:			
Crude ----------thousand 42-gallon barrels--	592,101	684,064	
Refinery products:			
Gasoline ----------do----	49,188	50,702	
Jet fuel and kerosine ----------do----	20,104	20,336	
Distillate fuel oil ----------do----	117,935	118,539	
Residual fuel oil ----------do----	72,015	79,793	
Lubricants ----------do----	2,254	2,301	
Other:			
Liquefied petroleum gas [1] --do----	1,273	1,303	Czechoslovakia 12.2%; East Germany 11.5%; Poland 10.2%; Bulgaria 8.9%; Finland 6.7%; Cuba 6.2%; West Germany 5.9%; Hungary 5.8%; Italy 5.3%.[3]
Paraffin ----------do----	609	523	
Asphalt and bitumen ----------do----	146	134	
Petroleum coke ----------do----	754	843	
Unspecified ----------do----	411	1,746	
Total ----------do----	264,639	276,220	
Crude chemicals from coal, gas, and oil distillation ----------thousand tons--	482	507	France 93; East Germany 63; West Germany 60; Italy 56.

r Revised. NA Not available.

[1] Data possibly incomplete; total not officially reported. Totals given here represent sum of quantities reported officially for all countries listed individually in source.

[2] Detail on principal destinations include shipments of vanadium slag and manganese metal, if any, to the listed countries, but total shipments of these commodities are reported separately under vanadium and manganese in this table.

[3] Detail on destinations of crude oil and refinery products are not officially reported separately. Total exports of crude oil and refinery products are reported by destination as a single total on a gravimetric basis, but this cannot be converted to a volumetric basis owing to the varying specific gravities of the different products that constitute the country total. Percentage figures provided here represent each country's share of total crude oil and refinery products exports on a gravimetric basis.

Table 3.—U.S.S.R.: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite ---thousand tons--	1,623	3,477	Guinea 1,844; Yugoslavia 947; Greece 611.
Alumina ---do---	886	1,029	Hungary 405; Jamaica 169; Guyana 121; United States 114.
Metal including alloys, semimanufactures	2,545	3,541	Austria 922; West Germany 607.
Antimony metal, unwrought	1,304	1,397	Yugoslavia 1,297; People's Republic of China 100.
Cadmium metal	264	262	Poland 200; North Korea 62.
Copper:			
Ore and concentrate [1]	19,036	22,248	All from Cyprus.
Metal:			
Unwrought, unalloyed	4,880	8,532	All from United Kingdom.
Semimanufactures:			
Powder [1]	1,600	1,650	All from West Germany.
Rolled:			
Unalloyed	7,746	8,099	Yugoslavia 4,317; Switzerland 618.
Alloyed	10,271	17,345	Yugoslavia 5,396; Sweden 949.
Iron and steel metal:			
Scrap [1] ---thousand tons--	15	14	All from Mongolia.
Pig iron ---do---	139	135	North Korea 41; India 9.
Ferroalloys ---do---	30	40	Norway 22.
Semimanufactures:			
Pipe ---do---	2,180	2,723	West Germany 921; Italy 551; Japan 237; Romania 210.
Wire ---do---	9	11	NA.
Other, rolled only ---do---	5,410	4,333	West Germany 1,163; Japan 976; Belgium 584; Austria 191; Poland 158.
Lead:			
Ore and concentrate [1]	39,062	54,644	All from Iran.
Metal, unwrought	77,214	56,700	Yugoslavia 15,782; North Korea 8,925.
Tin:			
Ore and concentrate [1]	2,710	468	All from Bolivia.
Metal, unwrought, unalloyed	5,235	9,654	Malaysia 5,161; United Kingdom 2,697; Bolivia 1,720.
Tungsten:			
Concentrates	7,044	8,120	NA.
Middlings [1]	80	154	All from Mongolia.
Zinc:			
Ore [1]	33,159	48,983	All from Iran.
Metal:			
Unwrought:			
Unalloyed	48,694	44,504	Poland 38,166; North Korea 6,338.
Alloyed	3,595	4,576	All from Poland.
Semimanufactures:			
Dust	1,203	579	Do.
Rolled	12,584	13,170	North Korea 9,476; Poland 1,547.
Other:			
Unwrought	3,717	5,940	NA.
Semimanufactures	4,781	5,549	NA.
NONMETALS			
Barite	239,009	329,544	Yugoslavia 95,332; North Korea 94,859; Bulgaria 85,320.
Cement, hydraulic ---thousand tons--	489	811	North Korea 500; Mongolia 33; Afghanistan 20.
Clay products, refractory [1]	1,031	NA	
Fertilizer materials, manufactured:			
Nitrogenous, ammonium nitrate [1]	15,004	15,426	All from North Korea.
Phosphatic	243,239	136,654	Sweden 50,139; United States 31,682.
Fluorspar	487,361	493,890	Mongolia 301,809; Thailand 58,479; People's Republic of China 55,407.
Magnesite:			
Crude [1]	32,712	23,645	All from North Korea.
Powder	356,237	406,503	North Korea 370,718.
Mica	725	498	All from India.
Quartz:			
Natural, for smelting ---kilograms--	1,220,000	NA	
Piezoelectric ---do---	2,956	NA	

See footnotes at end of table.

Table 3.—U.S.S.R.: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Salt [1]	100,658	99,921	All from People's Republic of China.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	209,176	194,331	Romania 45,128; Italy 42,000; Poland 22,589.
Soda ash	458,940	567,637	Bulgaria 448,307; Poland 71,801; Romania 44,087.
Caustic potash	5,326	7,519	West Germany 4,400; East Germany 1,219.
Sulfur	471,773	689,999	Poland 684,892; Canada 5,107.
Talc [1]	72,742	90,950	North Korea 60,000; Bulgaria 30,950.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	1,928	1,291	East Germany 1,020.
Coal, bituminous ——thousand tons	9,712	9,818	All from Poland.
Coke ——do	677	919	Do.
Gas, natural ——million cubic feet	421,867	438,500	Iran 337,571; Afghanistan 100,752.
Petroleum:			
Crude ——thousand 42-gallon barrels	32,459	48,521	Iraq 39,531; Algeria 3,038; Egypt 1,462.
Refinery products:			
Gasoline ——do	4,113	4,060	Romania 46.4%; United States 4.0%; Cuba 2.0%; United Kingdom 1.9%.[2]
Kerosine ——do	1,294	1,404	
Distillate fuel oil ——do	864	914	
Residual fuel oil ——do	558	NA	
Lubricants ——do	678	848	
Other:			
Solvents ——do	176	202	
Unspecified ——do	r 164	899	
Total ——do	r 7,847	8,327	

r Revised. NA Not available.

[1] Data possibly incomplete; total not officially reported. Totals given here represent sum of quantities reported officially for all countries listed individually in source.

[2] Detail on origins of refinery products are not officially reported separately. Total imports of all refinery products are reported by origin as a single total on a gravimetric basis, but this cannot be converted to a volumetric basis owing to the varying specific gravities of the different products that constitute the country total. Percentage figures provided here represent each country's share of total refinery products imports on a gravimetric basis.

COMMODITY REVIEW

METALS

Development of the ferrous and nonferrous metals industries lagged behind goals established for the 1976–80 5-year plan; however, production of metals and alloys continued to grow. Many products of the industry were not up to quality and variety requirements. Metallurgical plants frequently reported shortages in raw materials because of the postponement of scheduled leadtimes of new facilities for mining and processing.

Nonferrous ore beneficiation facilities continued to experience poor recovery of metal, particularly from oxide and mixed ores. Lead concentrates produced from mixed ores at the Zyryanovsk and Leninogorsk complexes in Kazakhstan contained about 60% of the lead contained in the ore, and zinc concentrates carried only 30% to 50% of the zinc contained in these ores. Some 80% to 90% of rare and dispersed elements was discarded in tailings at the beneficiation plants at Dzhezkazgan in 1976, according to official reports. As a result, the millions of tons of metallurgical slag at nonferrous metal plants of Kazakhstan contains more rare metals than does rich ore mined for production of these metals. At the Kadzharan copper and molybdenum mining and concentration complex in Armenia, some 16 million tons of tailings contain more copper and molybdenum than the ore mined in other places. Because of poor technology to utilize reverberatory gases and dust, large quantities of nonferrous metals were lost in 1976.

Serious shortcomings exist in the disproportion of officially explored and actual reserves of ores at many enterprises. For example, the copper complexes of Kazakhstan were hampered by the inability of the copper mines at Kounrad, Dzhezkazgan, and Sayak to reach design production as a result of overestimation of the quality and quantity of reserves, owing to poor geological study of the deposits.

Utilization of machinery and equipment continued to be considerably below the planned levels, and modernization and replacement of obsolete equipment was slow. As a result, productivity, even at advanced enterprises in Kazakhstan's nonferrous metals industry, was lower than at comparable enterprises in the West.

Soviet reports show that mining and metallurgical equipment is utilized at an average rate of 40% to 45% of designed working time. Downtime owing to breakdowns was common, according to reports.

Aluminum.—The U.S.S.R. is the world's second largest producer of aluminum; probable annual production capacity in January 1977 was 1.95 million tons. Estimated production in 1976 was about 1.75 million tons (including 150,000 tons of secondary), a 4% increase over 1975 output. Production fell short of the 6% planned increase because planned capacity goals had not been reached at seven aluminum plants, according to published Soviet reports, and output did not start at the new potline at the Krasnoyarsk plant in Siberia.

The increase in production of aluminum and alumina during the ninth 5-year plan (1971–75) was the highest in the industry's history. Under the new 5-year plan, output in 1980 is scheduled to be 30% above the 1975 level. To achieve these goals, it is planned to complete construction of the Bratsk and Krasnoyarsk plants, commission the first half of the Regar plant in Tadzhikistan, and complete construction of the first potline at the Sayanogorsk plant in Siberia. It is also planned to accelerate construction of additional alumina production facilities at the Bogoslovsk and Uralsk aluminum plants in the Urals. The Nikolayev alumina plant, with an annual capacity of 1 million tons, is to be completed by 1980. In the current 5-year plan, the regions east of the Urals are to account for the entire increase in the U.S.S.R.'s aluminum production. Soviet output of primary and secondary aluminum may reach 2.2 million tons by 1980.

In the 1976–80 period, an increase in output of crystalline silicon is to be accomplished by commissioning a silicon plant at the Irkutsk aluminum plant and expanding production of silicon at the Dneprovskiy aluminum plant. Increased fluoride salt production is to be provided through additional facilities built at existing plants and expansion of regenerated cryolite output. Considerable capital investment is being

directed to development of the aluminum industry in the 1976–80 period.

Aluminum is produced more for export than for domestic consumption, and the U.S.S.R. has exported over 500,000 tons in each of the past 4 years. Soviet exports are expected to increase to about 700,000 tons in 1980. The U.S.S.R. exports primary and secondary aluminum to Western European countries and Japan and plans to export large quantities to the United States in the future.

Construction continued at the Bratsk, Krasnoyarsk, and Regar primary aluminum plants. At Bratsk, the largest aluminum plant in the country, one potline was completed in 1976. The new potline at Krasnoyarsk, which was to come onstream in 1976, was not completed. The rated annual aluminum capacity of new Soviet potlines (korpus) is 30,000 tons.

PUK concluded an agreement for construction of a 1-million-ton-per-year alumina plant at Nikolayev on the Black Sea and a 500,000-ton-per-year primary reduction plant at Sayanogorsk, Krasnoyarsk Kray, in Siberia. Part of the cost (estimated at $2,600 million) will be repaid by product shipments to France. Construction of these plants, with the assistance of French experts, began in 1975. The alumina plant and the first potline of the refinery are to be completed during the 1976–80 period. Power is to be supplied by the Sayano-Shushensk hydroelectric plant, which is under construction.

Because of the delayed completion of scheduled construction of alumina and cryolite plants, there was a disparity between aluminum capacity and raw material supply. At many aluminum plants, more electrical power and materials are consumed per unit of production than is required with modern technology. In 1975, overexpenditures amounted to 4 million rubles. The Krasnoyarsk, Dneprovskiy, and Novokuznetsk aluminum plants used 500 to 1,000 kilowatt-hours more electrical power per ton of aluminum than the Soviet average. Mechanization of labor-intensive manual work in the Soviet aluminum industry is also making slow progress. For example, the degree of mechanization of work performed manually without machines in transportation and warehouse operations was 42.6%.

During the 1971–75 period, output of aluminum doubled at Bratsk. The first potline at the Regar plant, commissioned in 1975, attained design capacity in 1976. Three potlines at Regar were planned for completion by 1975, but only one had been constructed and put into operation as of September 1976. PUK assisted in constructing the plant and supplied some of the equipment. The second potline was under construction in 1976, and full operation was rescheduled for the 1980's. It is planned to make Regar the third largest producer after Bratsk and Krasnoyarsk. Regar operates on imported alumina.

Although the U.S.S.R. is a large producer of low-grade bauxite, supplies are insufficient and the country is developing alumina production from nepheline and alunite. Alumina is produced from nepheline at the Volkhov alumina-aluminum plant and the Pikalëvo complex in Leningrad Oblast using nepheline concentrate from the Apatit complex on Kola Peninsula, and at the Achinsk alumina plant in Siberia.

The nepheline-based alumina capacity in Leningrad Oblast is limited to processing only 1.5 million tons of nepheline concentrate. Because the quality of the nepheline concentrate decreased from 29% alumina in 1970 to about 28% in 1975, according to documentation, consumption of nepheline concentrate per ton of alumina must be at least 4.5 tons. Therefore, the Pikalëvo complex and the Volkhov plant could not have produced more than 335,000 tons of alumina from nepheline in 1975. The Achinsk alumina-from-nepheline plant, based on the Kiya-Shaltyrsk deposit, was reported to have achieved only 53.6% of its design capacity (800,000 tons per year) in 1975. A second nepheline mill, with an annual capacity of 2 million tons of concentrates, was reported under construction at the Apatit complex and is scheduled for completion in 1980.

Soviet output of primary aluminum in 1975 and 1976, by source of raw material, is indicated in the following tabulation:

Raw material	1975		1976	
	Thousand metric tons	Percent of output	Thousand metric tons	Percent of output
Bauxite	1,101	72.1	1,173	73.3
Nepheline:				
Kola Peninsula	169	10.9	167	10.4
Achinsk	215	14.1	215	13.5
Total	382	25.0	382	23.9
Alunite	45	2.9	45	2.8
Grand total	1,530	100.0	1,600	100.0

The principal reserves of bauxite are situated on the eastern slopes of the Urals, in the Turgay area of Kazakhstan, and in the Tikhvin region of Leningrad Oblast. The Northern Urals continued to be the main bauxite- and alumina-producing region. Four underground mines in this region were being expanded, but the opening of two new underground operations progressed slowly, and production was rescheduled for 1980.

Plans are to increase production of alumina at the Bogoslovsk aluminum plant in the Urals 52.5% in 1980 over 1975 output, using reserves of the Krasnaya Shapochka deposit. The plant consists of three sections; the first is to be commissioned in 1978, while the others are to be completed in 1979–80.

The second largest bauxite- and alumina-producing region is Kazakhstan, where the Pavlodar No. 1 alumina plant is among the nation's largest. The No. 2 alumina plant is under construction. During 1971–75, production of alumina at Pavlodar increased 23.7%. It is planned to increase alumina production in Kazakhstan 10% in 1980 over that of 1975. Completion of development of the Krasnooktyabr'sk and Belinsk open pits in northern Kazakhstan was rescheduled for 1980.

The Kirovabad alumina-from-alunite plant in Azerbaydzhan performed poorly in 1976. Massive capital investment was allocated to this plant for 1976–80. New facilities for alumina production were to be commissioned in 1976, but the goals were not met. The construction was undermanned by 50 to 70 persons, and available labor was not being fully utilized in 1976. Idle time was enormous. There were shortages of construction materials. The design for renovation was based on equipment which had not been produced by industry, according to official publications.

In 1976, important attention was being paid to improving the raw materials base and creating alumina facilities to overcome the gap between alumina and aluminum production capacity. A serious deficit in alumina production seems probable in the future. The U.S.S.R. is also seeking to meet the deficit by integrating the industries of Eastern Europe and by assisting with projects in Greece, Guinea, and India. Meanwhile, the U.S.S.R. continues to import substantial quantities of high-grade bauxite and alumina from Hungary, Yugoslavia, Greece, and Guinea.

Reportedly, the U.S.S.R. will build a 500,000-ton-per-year alumina plant in India. The $400 million project is to be financed by a loan from the U.S.S.R. and is to be repaid in alumina. The U.S.S.R. will help Indonesia build a 600,000-ton-per-year alumina plant on Bintan Island. The $360 million plant is expected to be completed by the early 1980's. The U.S.S.R. also agreed to construct an alumina-from-alunite plant in Iran. The U.S.S.R. and Algeria signed an agreement for construction of a $75 million, 140,000-ton-per-year aluminum plant at M'sila. The U.S.S.R. will finance the entire loan for the project, and repayment is to be in aluminum.

The U.S.S.R. operated 14 secondary aluminum units with a total estimated annual capacity of 185,000 tons in 1976. Production has been estimated at 150,000 tons of aluminum and aluminum alloys. The average selling price of secondary aluminum in the U.S.S.R. was about 490 rubles per ton in 1976.

A shop for production of secondary aluminum was put into operation at the Sumgait primary aluminum plant in Azerbaydzhan in November. New aluminum scrap is supplied to this shop by the Volgograd and Sumgait primary aluminum plants. The second stage of the Rustavi sec-

ondary nonferrous metals plant in Georgia was commissioned for the smelting of secondary aluminum in October 1976.

Antimony.—The Kadamdzhay complex in Kirgiz S.S.R. is the principal antimony center, where integrated facilities produce most of the country's refined products. Development continued on a new underground level at the mine, and ore extraction is to be doubled in the future. The recovery of antimony in concentrate at this complex increased from 89.5% in 1971 to 91.5% in 1976, and the metal content of the concentrates increased from 29% to 35%.

Construction of the new Aznob mine and mill unit (Dzhidzhikrutskiy complex) in Tadzhikistan continued slowly in 1976. Completion of the first stage was scheduled for 1975 but has been rescheduled for 1980. About 40 million rubles has already been invested on construction of the first and second stages, but the management of the project reported no set completion date. An antimony ore deposit associated with gold was under development at Sarylakh in Yakutia near the Arctic Circle.

Beryllium.—The U.S.S.R. continued to be the world's largest producer and one of the largest consumers of beryl, beryllium alloys, and metal in 1976. There are numerous deposits, mainly in Kazakhstan, Kola Peninsula, Transbaykal, the Urals, the Soviet Far East, and Western Ukrainia. Production is being expanded, and the probable level was 1,650 tons of beryl (10% to 12% BeO) in 1976. It is planned to recover beryllium from the ore of the Dzhidinsk tungsten and molybdenum complex in Buryat A.S.S.R.

Cadmium.—Cadmium is recovered at various Soviet lead and zinc smelters. Kazakhstan has recently become an important producer of cadmium. The Leninogorsk polymetallic complex in Kazakhstan, which increased cadmium production 25% during 1971–75, continues to be one of the largest producers. Production of cadmium was also increased at the Almalyk zinc plant in Uzbekistan and at the Balkhash polymetallic complex in Kazakhstan. Construction of facilities for cadmium recovery at the Dzhezkazgan complex in Kazakhstan continued in 1976. The U.S.S.R. has been the principal European cadmium supplier for many years, but in 1976 it made substantial purchases from Japan and Canada.

Chromium.—With an estimated output of 2.12 million tons, the U.S.S.R. was the world's second largest chrome ore producer and exporter in 1976. Almost 50% of production was exported, and 75% of this was destined to Western countries. Less than one-half was consumed in the U.S.S.R., as follows: Metal production 45%, refractories 32%, and chemical and other industries 23%. The price of Soviet metallurgical chromite ore was about $150 per ton f.o.b. Black Sea ports for 48% Cr_2O_3 ore with a 4:1 chromite to iron ratio. Ores with 54% to 55% Cr_2O_3 and a chromite to iron ratio of 4:1 represent the bulk of Soviet exports. The price of Soviet chrome ore sold abroad may be increased, depending on the embargo on Southern Rhodesian chrome ore.

According to a trade agreement, the Philippines will export chromite ores to the U.S.S.R. as payment for Soviet imports of platinum, palladium, and mining equipment.

Estimated data on production, exports, and consumption of chromite (Cr_2O_3) in selected years are as follows, in thousand tons:

	1970	1976	1980
Production (30% to 56%)	1,750	2,120	2,300
Exports (48% to 56%)	[1] 1,200	[1] 975	1,250
Consumption and stocks (30% to 56%)	550	1,145	1,050

[1] Reported in Soviet sources.

About 94% of total Soviet chromite reserves are situated in Kazakhstan, with the balance in the Ural Mountains. There are over 20 deposits in Aktyubinsk Oblast in western Kazakhstan; Molodëzhnoye, Millionnyy, and Almaz-Zhemchuzhina are the largest, with total gross reserves of some 60 million tons. Chromite ores in this region vary considerably with respect to composition; Cr_2O_3 content ranges from 5% to 63%. The Donskoy mining and concentration complex at Khromtau in Aktyubinsk Oblast of Kazakhstan, which produces over 90% of the Soviet output, is the only supplier of high-quality ore. Kazakhstan's chromite ore production is expanding each year.

There are many deposits of chromite ores in the Urals (Saranovskoye, Verblyuzhinskoye, Alapayevskoye, Monetnaya, Dacha, Khalilovskoye, etc.), the most important of which is the Saranovskoye deposit in Perm

Oblast. Deposits of chromium ores in the Urals, which have a low Cr_2O_3 content (20% to 40%) as well as a low chromite to iron ratio, are mostly used in the chemical and refractory industries.

The Donskoy deposits are presently mined selectively at five small open pits. The grade of most ores is adequate for direct shipping after hand picking. In 1976, 100-ton Unit Rig trucks and large Caterpillar bulldozers were used for the first time. There were two mills in operation at Khromtau in 1976, with a design capacity of 1.5 million tons per year of marketable ore (2.5 million tons of crude ore). The first Soviet chromite concentrator at Khromtau, with a capacity of 688,000 tons per year of marketable ore (950,000 tons of crude ore), has been under construction since 1965. The first section of this mill, with a capacity of 300,000 tons per year, was commissioned in 1974, and the second stage, which is under construction, is scheduled for operation in 1980.

The Cr_2O_3 content of the ores of the Donskoy complex was 45% for crude (to crushing mills) and 53.9% in marketable form. It is planned to increase production of marketable ore 10% in 1980 over that of 1975.[20]

Output of marketable chromite from the Saranovskoye underground operation is estimated at about 10% of total Soviet production, or about 200,000 tons. There was one crushing and grinding mill in operation at Saranovskoye in 1976, which classified ore into two sizes. After hand picking, the 10- to 100-millimeter-size ore was shipped to consumers. The recovery of ore in concentrate was about 70%, 16% was 0- to 10-millimeter-size and was dumped, and 14% was barren rock.

Cobalt.—Gross cobalt reserves are estimated at about 100,000 tons of contained metal, chiefly in nickel-cobalt ores and in cobalt ores of the Khovu-Aksy deposit in Tuva A.S.S.R. Production continued to be concentrated at Norilsk in western Siberia; at Monchegorsk and Pechenga on Kola Peninsula; in the Urals at the Yuzhuralnikel, Ufaley, and Rezhsk plants; and at some copper plants. Recovery of cobalt remained low, especially from the copper pyrite ore of Bashkiria. Only some 25% of the cobalt in slag was recovered. Average recovery was about 55%. The planned production cost of cobalt in concentrate at the Pechenganikel complex was 6,780 rubles per ton in 1975. It was reported that slow development and assay of ores at the Tuvacobalt complex resulted in low recovery in the beneficiation and metallurgical processes. Although cobalt production rose 16% between 1970 and 1975, it will probably remain constant during the 1976–80 period.

Copper.—Production of blister copper in 1976 was estimated at 965,000 tons, including 165,000 tons of secondary copper. The estimated 4% increase in output arose from new facilities commissioned in 1975. About 10% of primary copper output was recovered as a byproduct. Under the 1976–80 plan, output in 1980 is scheduled to be 20% to 30% over 1975 levels. The plan provides for 80% of the copper production to come from the Asian part of the U.S.S.R. and 20% from the European part by 1980. Output of blister copper may reach 1 million tons by 1977, rising to 1.15 million tons by 1980. Exports increased from 123,100 tons in 1970 to 205,600 tons in 1975. Estimated exports in 1976 were 250,000 tons, to rise to about 350,000 tons in 1980.

Reverberatory smelting continued to be the basic process for smelting of blister copper. According to Soviet sources, the changeover of most reverberatory furnaces to natural gas fueling has improved conditions for workers and made it possible to improve copper extraction; at the Almalyk complex in Uzbekistan and the Sredneural'sk plant in the Urals, the use of oxygen in the reverberatory furnaces made it possible to improve the melting of the charge 20% to 25%. In 1975, the Soviet copper industry used more materials and energy at a cost of 5.3 million rubles than was planned. Plans are to replace reverberatory smelting of blister with the oxygen-flash smelting process at the Krasnouralsk plant in the Urals.

Kazakhstan maintained its position as the main production center of the U.S.S.R., and the Balkhash complex was the largest copper producer in 1976. The 1976–80 plan calls for a 25% increase in refined copper production in Kazakhstan. Published plans called for an increase of 6% in 1976 over that of 1975. Open pit methods, which accounted for about 60% of total output in

[20] Izvestiya vysshikh uchebnykh zavedeniy, Seriya gornyy zhurnal (University Herald, Seria Mining Journal), Sverdlovsk. No. 2, February 1976, p. 21.

1976, employ both rail transportation and 40-ton off-highway trucks. The second stage of the No. 65 underground mine at Dzhezkazgan was put into operation in July 1976. Development of the third and final stage of this mine was not completed in 1976 and was rescheduled for 1977. Only 48% of the total value of metals in Dzhezkazgan ores was recovered in 1976, according to trade journal reports.

Expansion of the Kounrad open pit at the Balkhash complex continued in 1976 and was scheduled for completion in 1979. News accounts reported that a shortage of spare parts idled the shovels at this pit for a substantial time in 1976. Development of the Sayak open pit at Balkhash was completed in 1976. Recovery of copper in concentrate at the Balkhash beneficiation mill decreased from 89.44% to 85.92%, and the copper content of the concentrate decreased 1%, according to Soviet trade journals.

Development of the first stage of the Novoberëzovka underground mine at the Irtysh polymetallic complex in Kazakhstan was completed in April 1976. At the pilot plant of this complex, a Kivtset process (electrosmelting with oxygen blasting) for treating copper-zinc sulfide concentrates was tested. It is planned to complete the first stage of the Karaygalinsk, Orlovsk, and Nikolayevsk mills by 1980 and to construct an additional smelting unit at the Irtysh complex in Kazakhstan. Development of the 50-let Oktyabrya mine in Aktyubinsk Oblast, western Kazakhstan, continued in 1976. Exploration for new copper deposits in Kazakhstan continued, but news accounts reported that the shortage of drilling rigs and trucks limited operations.

The Urals is the second largest copper-producing region. Copper ore is surface-mined at Uchalinskiy, Mezhozerskiy, Sibayskiy, and Gayskiy, and deep-mined at Degtyarsk, Karabash, Gayskiy, Imeni III International, and Levikhinskiy. The share of surface mining increased from 39.3% in 1958 to over 70% in 1976. This was attributed to the development of the Gayskiy, Uchalinskiy, and Ob'edinennyy open pits of the Uchalinskiy complex and the decline of the Degtyarsk, Krasnouralsk, and Karabash underground mines. This trend is expected to continue, although the Krasnouralsk, Kirovograd, and Karabash copper smelters in the Northern Urals were experiencing a major shortage of concentrates. One-third of the total smelter consumption was transported from Soviet Central Asia, the Altay region, the Caucasus, and other regions.

The detailed exploration of the Kal'makyr deposit at the Almalyk complex in Uzbekistan which started in 1951 was completed in 1976. Ore reserves increased 50%. The Sarycheku copper deposit has also been delineated, and the development of an underground mine is to start there in 1977. It is planned to complete exploration of the Dal'neye and Balykty copper deposits in Uzbekistan by 1980.

The Kafan and Agarak copper-molybdenum complexes and the Alaverdy metallurgical plant showed poor performance in 1976. The planned production goals were not met. The recovery of copper in concentrate and in blister was far below design expectations. Much copper and molybdenum is lost during the concentration and metallurgical processes, according to local press accounts. During 1967–74, labor productivity at the open pit of the Kafan complex decreased 16.7%.

The percentage recovery of copper in concentrate at the principal Soviet copper ore-dressing plants in 1976 was as follows:

Plant	Copper content of ore		Copper content of concentrate		Recovery of copper in concentrate	
	Design	Actual	Design	Actual	Design	Actual
Kazakhstan:						
Balkhash	1.35	0.6	20.0	18.87	90.0	85.92
Dzhezkazgan No. 1	2.0	1.81	20.0	37.8	93.0	93.37
Dzhezkazgan No. 2	1.76	1.62	25.0	35.89	94.0	93.53
Uzbekistan: Almalyk	.80	.732	18.0	17.1	83.0	73.82
Armenia:						
Agarak	.64	.659	21.0	18.68	82.83	75.02
Kadzharan	.60	.342	22.0	12.21	78.0	70.88

The bulk of Soviet secondary copper is produced at the Kirovograd copper complex in the Urals. Productivity of blast furnaces at this plant is 80 to 85 tons. Only 16% of copper scrap is used for production of special alloys, 50% is used for production of

bronze and brass, and some 34% is remelted at blast furnaces and converters for blister. Trade journals report that the quality of copper scrap is declining each year.

According to Soviet sources, gross reserves of the Udokan deposit in eastern Siberia amount to about 1,200 million tons of ore with an average copper content of 1.5% (20% oxides, 80% sulfides). Plans are to develop this deposit in 1981–90 and to produce 35 million tons per year of ore yielding a refined copper output of 400,000 tons per year. The U.S.S.R. has been negotiating with British, French, and Japanese companies to develop the Udokan deposit "jointly." At the same time, the U.S.S.R. was assisting Mongolia in construction of the Erdenet copper-molybdenum complex and has offered assistance to India to consider the feasibility of establishing a copper operation there.

Gold.—In 1976, the U.S.S.R. produced an estimated 7.7 million troy ounces of gold and was the world's second largest producer. Over two-thirds came from the Soviet Far East and eastern Siberia (mainly from placers at Kolyma, Aldan, Dzhugdzhur, Indigirka, Yana, and Chukotka); most of the balance came from gold and polymetallic ores in the Urals, Kazakhstan, Armenia, Uzbekistan, and western Siberia. Substantial quantities are produced as byproduct at the nonferrous metals operations.

Soviet gold production has maintained a steady annual growth rate of 3% to 4% over the years. Prompted by higher international prices, the U.S.S.R. plans to increase production and has been importing large-scale equipment from Western Europe, the United States, the Republic of South Africa, and Japan. Based on ore reserves, geological and mining conditions in the country's largest gold-producing regions, and fragmentary, indirect reporting, production is estimated to be 248 tons in 1977 and 270 tons in 1980.

Because data on gold sales are classified as State secrets, there are no accurate figures, but according to some estimates, the U.S.S.R. sold more than 200 tons of gold in 1976, compared with some 140 tons in 1975. Reportedly, the Soviet Bank for Foreign Trade concluded an agreement with Continental Gold Corp. for direct sales to the United States.

Magadan Oblast is the main gold-producing center with 32 placer mines, 23 dredges, over 500 sandwashing rigs, and about 1,500 bulldozers. The Severovostokzoloto Association of Magadan Oblast fulfilled its 1976 gold production quota by November 5. Despite a considerable deterioration of geological and mining conditions in working placer deposits, the use of new foreign equipment made it possible to handle a considerably greater volume of stripping in 1976 than in 1975. The Polyarny, Bilibino, and Tenkin complexes fulfilled their annual gold extraction quotas by September, owing largely to dredges especially at the Frunze placer mine.

The Northeastern Territorial Geological Organization of Magadan Oblast did not fulfill the 5-year planned quota for discovery and exploration of additional placer gold reserves. There were shortcomings in the preparation of gold mining enterprises of the Severovostokzoloto Association for the 1977 season. Trade journals reported that a shortage of electrical power was causing difficulties in the operation of many enterprises in 1976. During 1965 to 1975, return on capital decreased 37.1%.

At Magadan placers, the thickness of overburden, which was up to 5 meters in the 1971–75 period, is expected to increase to 15 meters by 1980. The use of bulldozers for overburden removal will decrease from 86% in 1975 to 24% in 1980, when excavators and trucks will be employed. Mining journals report that during 1977–80, because of the deterioration of geological and mining conditions, the mining of placers by underground methods will become complex. Recently delivered foreign heavy bulldozers were assigned to the preparation of new mining sections. Construction of the Kramken mining and concentration complex in Khasinskiy Rayon and the Dukat ore mine in Magadan Oblast, both of which are classified as "most important enterprises," was behind schedule.

In Yakutia, the second largest gold-producing region, the mines of the Indigirzoloto and other complexes were supplied with new imported bulldozers, trucks, and large scrapers. Four enterprises of the Kazzoloto Association did not meet the annual planned quotas, according to news accounts, and the recovery of gold at some enterprises decreased 3% to 3.5% in 1976.

The first stage of the Zodskiy mining and concentration complex in Armenia, which

has been under construction since 1970, was put into operation in April 1976. The Zodskiy open pit, which is located in the mountains more than 2,000 meters above sea level, ships ore to the gold recovery plant in the Ararat Valley by the Sevan-Shora-Zod railroad. The Zodskiy ore is complex and difficult to concentrate. About 33% of design capacity at the Zodskiy open pit was attained in 1975 and about 50% in 1976; design capacity is expected to be reached by 1980. Plans are to put the second stage of the Zodskiy complex into operation and to develop the Shaumyan deposit by 1980. The Ararat gold-recovery plant is to process ores from the Zodskiy, Shaumyan, Megradzorsk, Lirkvazsk, and other deposits in Transcaucasia and the North Caucasus. Detailed exploration of the Shaumyan deposit continued in 1976.

Published accounts report dissatisfaction with the byproduct recovery of gold at all copper-molybdenum enterprises of Armenia.

Iron Ore.—The iron and steel industry of the U.S.S.R. operated 71 underground mines and 63 open pits with a total capacity at the beginning of 1977 of 274 million tons of usable ore (532 million tons of crude ore). Over 82% of ore production was from open pits; seven major pits, each producing over 10 million tons per year, contributed almost one-half of the total.

Reported production of usable ore was 238.4 million tons (455 million tons of crude ore), an increase of 6.45 million tons over that of 1975. Production of usable ore is scheduled to reach 243.3 million tons (477.5 million tons of crude ore) in 1977, and 277.6 million tons (560 million tons of crude ore) in 1980. The 1977 production plan set goals of 166.6 million tons of concentrate, 158 million tons of sinter agglomerate, and 36.4 million tons of pellets. Exports of iron ore increased from 38.4 million tons in 1972 to 43.1 million tons in 1976. The principal increase was in exports to CMEA countries, which account for 90% of total exports. In 1976, 45 million tons of new annual production capacity was added, compared with 27.3 million tons of new capacity in 1975.

There were 92 iron ore concentrators, of which 29 had sintering and 6 had pelletizing facilities in operation in 1976. Iron ore production in the U.S.S.R. is shown in the following tabulation:

	1975	1976
Output of usable ore million metric tons	r 231.95	238.40
Iron content of usable ore percent	59.30	59.32
Iron content of crude ore, concentrated do	32.60	32.59
Output of iron ore concentrate million metric tons	150.97	159.15
Iron content of concentrate percent	62.50	62.44
Share of concentrated ore do	82.10	82.50

r Revised.

Source: Gornyy zhurnal (Mining Journal), Moscow. No. 1, Jan. 1, 1977, p. 6.

The iron content of ores from open pits was 34% in 1975 (34.6% in 1971); that of ores from underground mines was 46.4% (47.3% in 1971). Soviet iron ore operations are not able to meet the demands of industry in all regions. The local raw material base for steel plants in the Southern Urals continued to be under stress. Many years of prospecting there have not led to the discovery of large iron ore deposits.

The new 5-year plan calls for the output of 122 million tons of pig iron and 154 million tons of crude steel in 1980. To meet this plan, it will be necessary to produce 277.6 million tons of usable ore (560 million tons of crude ore), including 203 million tons of concentrates (a 35.2% increase over that of 1975) and 60 million tons of pellets (a 91.1% increase). The increase is to come mainly from the opening of new open pits and the expansion of existing complexes: Lebedin, Mikhaylov, Kachkanar, Olenogorsk, Kovdar, Severnyy, Dneprovsk, and others. The share of open pit ore production is to increase from 82% in 1975 to 83% in 1980. The volume of underground ore production is to be increased 20% by 1980, and the average annual production capacity of the mining administrative unit should increase from 2 million tons of crude ore in 1975 to 2.9 million tons in 1980.

Soviet iron ore mining is generally less efficient than equivalent operations in the West, owing to a technical lag stemming from poor dissemination of technical knowledge and technically inferior equipment. Despite considerable mechanization, productivity of Soviet miners has been much below that of miners in the West. Ore beneficiation in the Soviet iron ore industry is less sophisticated. Agglomeration techniques are copies of old-fashioned

Western sintering; modern pelletization has been introduced with the assistance of Western firms but still has a very limited application.

The Ukraine accounted for over 52% of total Soviet iron ore output, and the Krivoy Rog Basin produced about 89% of the Ukraine's total in 1976. The Urals was the second largest producer, followed by Kazakhstan, Kursk Oblast, Siberia, and Kola Peninsula. There were 23 underground mines and 9 large and several small open pits in operation in Krivoy Rog in 1976. Lack of mechanization in the auxiliary operations of underground mining in this basin resulted in low labor productivity. Support of workings, installation of mining equipment, all forms of transportation and delivery of materials, and many other operations in most cases were not fully mechanized. Soviet documentation shows, for example, that more than 2,300 workers were engaged daily just in support of workings in Krivoy Rog in 1976.

Construction of the first stage of an iron ore pelletizing plant at the Dneprovsk complex in the Ukraine, with assistance and equipment supplied by Allis-Chalmers Corp., was completed in December. A West German group, Lurgi Chemie und Huettentechnik GmbH, will supply equipment for a pelletizing plant in Krivoy Rog. The design capacity of the plant will be 9 million tons per year of pellets.

Construction of the Lebedin iron ore mining and concentration complex in the Kursk Magnetic Anomaly (KMA) area (Belgorod and Kursk Oblasts), with an annual capacity of 13 million tons of concentrates (39 million tons of crude ore), was completed in November. The pellet plant at Lebedin achieved its design capacity of 4.3 million tons per year of pellets in July. This is to be supplied to the Oskol electrometallurgical complex (which is under construction) for production of steel by direct reduction. The first stage of the pellet plant at the Mikhaylov complex in the KMA area, with an annual capacity of 3.1 million tons of pellets, was commissioned in December. According to the tenth 5-year plan, production of crude iron ore in the KMA area is to reach 88 million tons per year by 1980.

The Urals metallurgical plants, which treat some 53 million tons per year of usable ore, are supplied by the Urals (some 26 million tons), Kazakhstan (some 18 million tons), and the KMA area and Kola Peninsula. Transportation of Kursk and Kola Peninsula ores raises the cost of metal substantially, according to documentation.

The iron ore for the Kuznetsk complex in Siberia is shipped from six mines. The first stage of the seventh mine, the Krasnokamenskaya mine, with an annual capacity of 1 million tons of concentrates (1.8 million tons of crude ore), was completed in April. Construction of the Kachar mining and concentration complex in Kustanay Oblast, Kazakhstan, started in June. There were 800 workers in the development of an open pit at this complex in 1976.

Iron and Steel.—The Soviet iron and steel industry leads the world in total quantity of iron ore mined and in production of coke, refractories, crude steel, and steel pipe. Each year, the plan for rolled steel output is overfulfilled, while at the same time there is a shortfall in deliveries of millions of tons of rolled products. A great proportion of the supply of rolled products and distribution of the output by specific products does not match the products in demand. In spite of large imports of rolled products, shortages of many steel products in the U.S.S.R. raise problems in the Soviet economy.

According to the chief specialist of the U.S.S.R. Planning Committee, "The U.S.S.R. expends 1.5 times more ferrous metals per unit of output than the United States. This is explained by the inadequate level of their quality, the narrower assortment, the insufficiently progressive production structure and the backwardness of the technology for processing metals.

"... There are 2 to 3 times more steel and iron chips formed in the U.S.S.R. than would be necessary with modern technology. This resulted in loss of 3 to 4 million tons of metal worth about 2,000 million rubles a year, not counting the 5,000 million rubles worth of capital investments in plants where the metal is processed. For excess chips it is necessary to increase production of approximately 20 million tons of metallurgical raw materials (ore, coke, refractory and other materials) annually and to create capacity for production of raw materials. . ." [21]

[21] Ekonomika i organizatsiya promyshlennogo proizvodstva (Economics and Organization of Industrial Production), Novosibirsk. No. 3, May-June 1976, pp. 29-40.

In 1976, 36 enterprises, operating 137 blast furnaces, produced 104.4 million tons of pig iron, a 2% increase over the 1975 output. Estimated figures for 1977 and 1980 are 110.2 million tons and 120 million tons, respectively. The average blast furnace capacity increased from 1,135 cubic meters in 1971 to 1,258 cubic meters in 1976. About one-half of all blast furnaces use oxygen for enrichment; over 83% of the pig iron was being produced by the use of natural gas injection and 75% by use of oxygen enrichment. More than 184 million tons of iron ore, 20.5 million tons of flux, 61.2 million tons of coke, 8,200 million cubic meters of natural gas, and 10,200 million kilowatt-hours of electricity were used in the production of pig iron in 1976.

The capacity (useful volume) of the 137 Soviet blast furnaces in 1976 averaged 1,258 cubic meters and was distributed as follows:

Capacity (cubic meters)	Number of furnaces
123 to 600	42
600 to 725	10
930 to 1,060	23
1,140 to 1,242	10
1,300 to 1,410	24
1,500 to 5,000	28

Production of the different types of pig iron in 1976, in percent, was as follows:

Steelmaking	91.0
Foundry	8.0
Ferromanganese	.9
Other	.1

Construction of the No. 6 blast furnace (3,200 cubic meters; 2.9 million tons per year of pig iron) began at the Novo-Lipetsk plant in 1976. Completion was scheduled for 1978. The blast furnace that was being built at the Kommunarsk works in the Donets Basin was to be put into operation by 1977. Reportedly, a blast furnace with a capacity of 5,500 cubic meters was being designed in Leningrad. The new furnace is to be built at the Cherepovets plant. It is to be 110 meters high and 15.1 meters in diameter and is to produce 4.5 million tons per year of pig iron.

Crude steel production from 76 metallurgical works increased 2% to reach 145 million tons in 1976 (planned goal, 147 million tons). It is planned to produce 151.1 million tons of crude steel in 1977 and 168.5 million tons in 1980.

Distribution of steel production by process was as follows, in percent:

Process	1960	1970	1976
Open hearth	84.4	72.6	64.0
Oxygen converter	3.8	15.3	28.0
Electric furnace	8.9	10.7	7.4
Bessemer	2.9	1.4	.6

There were 41 continuous-casting machines, with a total annual capacity of 10 million tons, in operation in 1976. At year-end 1975, there were 37 operating oxygen converters, of which 30 had capacities of 100 tons or more. Renovation of the No. 1 converter shop at the western Siberian plant began in 1976. The average annual capacity of newly constructed oxygen converters increased from 855,000 tons in 1960–70 to 1.72 million tons in 1971–75. The Soviets have been proceeding slowly in the installation of Linz-Donawitz oxygen converters, although several 300-ton units are in operation.

Electric steel production was characterized by lower capacity furnaces and power transformers. The largest size of electric furnace was 100 tons and of transformer, 25,000 kilovolt-amperes. At the Azovstal' plant in Zhdanov and the Lenin works in Bekabad, Georgia, electric furnace shops (one at each location) were under construction in 1976.

Soviet ferrous rolled metals output in 1976 totaled 118 million tons (of which 101 million tons was finished products), a 2.3% increase over that of 1975. Despite increases in total output, production of many structural shapes remained inadequate. Output of rolled products is measured in tons, and since quotas, premiums, and incentives emphasize quantity, metallurgical plants tend to favor heavy products at the expense of thin sheet and light sections. It was planned to produce 105.4 million tons of finished ferrous rolled metals in 1977 and 117.5 million tons in 1980.

In terms of tonnage, the U.S.S.R. was the largest world producer of steel pipe, with a total of 16.8 million tons in 1976, a 5% increase over the 1975 production. The quality of the pipe produced in the U.S.S.R. does not always correspond even to the prescribed State standards. Fabrication was, however, inadequate for internal demand, and some 25% of requirements had to be imported from Western Europe and Japan.

About 60% of total Czechoslovak pipe production goes to the U.S.S.R. It was estimated that production of steel pipe may reach 17.6 million tons in 1977 and 20 million tons in 1980. Renovating existing pipe plants, eliminating obsolete equipment, and improving the quality of pipe are to continue during 1977–80. One of the main tasks facing Soviet pipe production is to increase the quantity and quality of pipe for the petroleum and natural gas industries.

New, expanded, or renovated production facilities commissioned during the year follow, in million tons: Pig iron, 2.25; crude steel, 1.2; and finished ferrous rolled metals, 4.0. The following main facilities were put into operation: The renovated blast furnace No. 1 at the western Siberian plant, new facilities of the No. 2 oxygen converter plant at the Il'ich plant in Zhdanov, a 70-ton electric furnace at the Novo-Lipetsk plant, a new medium-size section mill with an annual capacity of 1.5 million tons at the western Siberian works, and a light section mill at the Nizhneserginskiy plant. The first stage of the pipe-rolling mill, with an annual capacity of 320,000 tons of casings for the petroleum and gas industries, was put into operation at the Severskiy pipe plant in 1976, as were a new section (with a capacity of 15,700 tons per year) at the Azerbaydzhan pipe plant and a renovated pipe-rolling mill at the Pervouralsk pipe plant in Sverdlovsk Oblast.

Reportedly, the steel strip-coating plant supplied by four British companies was put into operation at the Chelyabinsk plant in September. The plant has an annual capacity to coat 90,000 tons of steel strip and to roll 100,000 tons of galvanized strip up to 1,500 millimeters wide.

Expansion and renovation of the western Siberian works and the Rustavi plant in Georgia were underway in 1976. Technical plans for renovation of the first stage of the Magnitogorsk complex were approved in December. During 1977–80, it is planned to expand the first stages of the Magnitogorsk, Novo-Lipetsk, and Karaganda complexes, the Serp i Molot plant in Moscow, the Krasnyy Oktyabr plant in Volgograd, and the Il'ich plant in Zhdanov. The plan for renovation of ferrous metallurgical plants includes 3 blast furnaces, 6 steel-smelting units, 26 rolling units, and 23 pipe mills. During the 1976–80 period, it is planned to invest 20,900 million rubles in the ferrous metals industry and to construct new production facilities, including blast furnaces at the Cherepovets and Novo-Lipetsk plants with capacities (useful volumes) of 5,000 to 5,500 cubic meters and 3,200 cubic meters, respectively.

A preliminary technical plan for the first stage of the Oskol electrometallurgical complex was submitted by West German experts to the U.S.S.R. Ministry of Foreign Trade in July 1976. More than 3,000 West Germans are expected to be working on the project in the Saryy Oskol-Kursk region. More than 6,400 Soviet workers were employed on the construction of this complex in 1976. The Oskol complex will be the first direct-reduction steel plant in the Soviet ferrous metals industry.

According to the West German project, iron ore concentrate containing more than 70% iron will come to the Oskol works from the Lebedin mining and concentration complex. The concentrate is to be reduced by natural gas to make 90% to 92% iron content sponge iron, which will be charged continuously into electric steel-smelting furnaces. The project provides for an ore-pelletizing plant with an annual capacity of 7.3 million tons, a direct-reduction plant with an annual capacity of 5 million tons of sponge iron, an electric steelworks and continuous-casting plant with an annual capacity of 3.75 million tons, a profile steel-rolling mill with an annual capacity of 1.5 million tons, a sheet mill with an annual capacity of 1.2 million tons, and ancillary facilities. The total land dimensions of the complex are to be 3.7 kilometers by 2.1 kilometers, and the population of the new town to be established is expected to be more than 300,000 in the early 1980's.

The first stage of the Oskol electrometallurgical complex, with an annual capacity of 4 million tons of iron pellets (two lines), 2.5 million tons of sponge iron, 1.8 million tons of crude steel (four electric furnaces with a capacity of 200 tons each), and 1.5 million tons of rolled products, is to be completed by 1980. More than 1,500 million rubles is to be invested in the project during the 1976–80 period.

The U.S.S.R. was signing contracts for new Western technology and machinery to increase its steel output and upgrade steel products, especially tinplate, steel sheet, and electric steel. About one-half of these pur-

chases involved rolling mills. In addition to imports from Hungary, East Germany, Poland, and Czechoslovakia, rolling equipment was imported from the United Kingdom, West Germany, and France. At the same time, the U.S.S.R. was assisting in the renovation of the Isfahan steelworks in Iran. The design institute in Leningrad has begun preparing technical plans for an iron and steel plant in Yugoslavia, with an annual capacity of 1.5 million tons of crude steel. The U.S.S.R. will also be one of the suppliers of equipment for the project. The U.S.S.R. was also involved in construction of a 1.1-million-ton crude steel plant in Karachi, Pakistan.

Lead and Zinc.—The Soviet lead and zinc industry was probably the second largest in the world. Estimated output of primary metal in 1976 was 500,000 tons of lead and 720,000 tons of zinc. Production in 1980 is estimated to be 530,000 tons of lead and 760,000 tons of zinc. Lead exports increased from 92,400 tons in 1970 to 98,900 tons in 1975, and zinc exports rose from 95,100 tons to 100,600 tons in the same period. In 1976, the U.S.S.R. imported a substantial quantity of zinc from Japan. According to Soviet documentation, many of the Soviet lead and zinc production complexes did not attain their production capacities and recovery of metals. Nor were output quotas achieved in 1976 owing to ore shortages, slow construction of new facilities, and low metal recoveries. About 10% of total lead and zinc production was recovered as byproduct in 1976.

Kazakhstan continued to be the leading lead and zinc producer, followed by the Urals, Siberia, Uzbekistan, the North Caucasus, and the Ukraine. Production of lead-zinc ores in Kazakhstan increased 13.6% and that of lead metal rose 14% during the 1971–75 period.

New lead and zinc production facilities commissioned in 1976 include the Achisay, Zhayremsk, and Leninogorsk complexes in Kazakhstan, the second stage of the Sadovyy mine, and the first stage of a new mine of the Dalpolimetal (Far East Polymetallic) Association. This Association was established on the basis of the Dal'nevostochnyy Lenin mining and metallurgical complex (at Tetyukhe) and the Dal'nevostochnyy mining and concentration complex in September 1976. A new smelting furnace at the Chimkent lead plant in Kazakhstan was put into operation in November.

Reportedly, the first automatic control system in the U.S.S.R. was installed at the concentrator of the Zyryanovsk lead complex in Kazakhstan in November. At the concentrator of the Leninogorsk complex, a new dense-media beneficiation section was commissioned in 1976. This is the fourth heavy-media section to be installed in the Soviet nonferrous metals industry. According to news accounts, the Leninogorsk mining and metallurgical complex in Kazakhstan did not use 3.8 million rubles of funded programmed capital investments in 1976.

The 1976–80 plan calls for an increase in lead and zinc ores and concentrates production by completion of the Zhayremsk and Karayglinskiy complexes in Kazakhstan, increasing capacities at the Achisay and Ust-Kamenogorsk metallurgical complexes in Kazakhstan, and renovation of the Belovskiy (Siberia) and Elektrotsink (Ukraine) zinc plants and the Dalpolimetal Association's lead plant in Maritime Territory.

Priority is to be given to discovery and exploration of new and existing lead and zinc ore deposits.

Magnesium.—Five magnesium plants with an estimated combined annual capacity of 70,000 tons produced about 63,000 tons in 1976, 5% more than in 1975. Exports of metal decreased from 27,900 tons in 1974 to 11,400 tons in 1975. The U.S.S.R. is still one of the largest producers and exporters of magnesium. A renovation program employing a new electrolysis system has been partially completed, yielding an increase in capacity of about 20%.

Reportedly, during the ninth 5-year plan, output of magnesium and its alloys increased 20.2%. In 1976, magnesium produced by the Berezniki titanium and magnesium complex was the cheapest in the country. According to the 1976–80 plan, output of magnesium and its alloys is to increase 23.3% to 74,000 tons by 1980 from an estimated 60,000 tons in 1975.

Manganese.—The Soviet manganese industry remains the largest in the world, with an output of 8.2 million tons of marketable ores. Gross output in 1976 was about 20 million tons, of which over 70% came from the Nikopol basin in the Ukraine; the second largest producing area was the Chiatura basin in Georgia. Small

amounts of manganese were produced at the Dzhezdinsk and Atasuysk mines in Kazakhstan. Exports of manganese ore increased from 1.2 million tons in 1970 to 1.34 million tons in 1976. Estimated production of marketable ore in 1977 and 1980 is placed at 8.3 million tons and 10 million tons, respectively.

Two concerns, Ordzhonikidze and Marganets, operate in the Nikopol manganese basin. There were 18 underground mines, 10 open pits, and 8 concentrators in operation in 1976. More than 75% of the ore mined in the Nikopol basin came from open pit operations. Nikopol basin ore averages 26.4% manganese. Of the concentrated ore, 45% to 48% had a manganese content of over 45%; the balance contained 34%. The second stage of one of the concentrators at the Marganets complex (with a capacity of 1 million tons per year of crude ore) was under development.

The Chiatura basin in Georgia produced about 2.5 million tons of concentrates from 23 underground mines and open pits and 8 concentrators in 1976. Of the total beneficiated ore, two-thirds contained 48.7% manganese and the balance contained 25.6% manganese. Development of four small mines began in 1975. They are to be commissioned during 1977–80.

Mercury.—Output of mercury was estimated at 56,000 76-pound flasks, an amount sufficient to meet national requirements in 1976. The Khadarkan complex in southern Kirgiz S.S.R., the largest Soviet mercury operation, had four mines and a recovery plant in operation. At this complex, mercury is mined by both underground and open pit methods. Sinking of the Ulug-Too shaft at the complex began in 1976. It is to be 850 meters deep, the deepest shaft in Soviet Central Asia. After full capacity is attained at the Ulug-Too mine by 1980, output of mercury will be increased 10%. Renovation of metallurgical facilities at the Khadarkan complex began in 1976 and is scheduled for completion in 1980.

The Nikitovskiy complex in the Ukraine, where 80% of ore is mined by underground and 20% by open pit methods, is the second major producer of mercury. Two underground mines (2-bis Novaya and Novo-Zavodskaya) and the Polukupol Novyy open pit were in operation at this complex in 1976.

Mercury output in Magadan Oblast was higher in 1976 than in 1975. Construction of the new Dzidzikrutskiy (Aznob) mercury-antimony complex in Takzhikistan continued during the year. Completion of the first stage of this complex has been rescheduled from 1976 to 1980. Development of small deposits is planned in the North Caucasus, at Chukotka in Magadan Oblast, and in other regions of the U.S.S.R.

Molybdenum.—Output of molybdenum concentrates was estimated at 9,350 tons of contained metal, 3% above that of 1975. About 50% came from copper-molybdenum ores in Armenia, Kazakhstan, Sorskoye, and other areas in Siberia; over 30% came from molybdenite ores in Uzbekistan and Siberia; and the remainder came from tungsten-molybdenum ores of Tyrny-Auz (Kabardia in the North Caucasus) and Dzhida (Buryat A.S.S.R.). Production of molybdenum in the U.S.S.R. has quadrupled during the last 20 years and is expected to reach 10,700 tons by 1980. Soviet reserves of molybdenum in ore may approach 200,000 tons.

Armenia was the largest producer of molybdenum concentrates from copper-molybdenum ores, but the concentrate was shipped out of the Republic for further treatment. The Kadzharan copper-molybdenum complex in this Republic supplied over 20% of Soviet molybdenum in 1976. Output of molybdenum concentrates at this complex is to be increased by 1980.

Construction of the Zhireken molybdenum complex in Chita Oblast, completion of which was originally planned for 1975, lagged behind schedule in 1976. The Eastern Kounrad No. 6 underground mine for producing molybdenum, tungsten, and bismuth was completed at the Balkhash complex in Kazakhstan. The Kounrad open pit at this complex was being enlarged, and small open pits were being developed at the Sayak copper deposit. Development of the Mikulanskiy open pit at the Tyrny-Auz tungsten and molybdenum complex continued in 1976. Plans have been prepared for renovation of the Tyrny-Auz concentrator. When the open pit and new concentrator are commissioned, the complex will be able to increase production 70%.

Preliminary exploration of a small molybdenum deposit at Upchul'skoy in Krasnoyarsk Kray was completed in 1976. It is planned to complete detailed exploration

of the Dal'neye copper-molybdenum deposit at the Almalyk complex in Uzbekistan by 1980. It is also planned to increase the processing of tungsten-molybdenum ores at the Akzhalsk concentrator of the Akchatausk complex in Kazakhstan 80% during 1977–80.

Nickel.—The U.S.S.R. retained its position as the world's second largest producer of nickel, with an estimated 160,000 tons of smelter products, 5.3% more than in 1975. It is planned to increase metal production 20% to 30% in 1980 over the 1975 output. Production is estimated at a probable 168,000 tons in 1977 and 190,000 tons in 1980. Sulfide ores are mined at Norilsk in western Siberia and in the Pechenga-Monchegorsk area of Kola Peninsula. Oxide ores are produced in Aktyubinsk Oblast in the Southern Urals, the Ufaley area of the Middle Urals, and the Ukraine. The centers of production, in order of importance, continued to be Norilsk, the Urals, and Kola Peninsula. Of the seven smelters in operation, Norilsk is the most important; the Ufaley, Rezh, and Khalilovo smelters in the Urals are close seconds. The Monchegorsk and Pechenga smelters are third, and the Pobuzhsk ferronickel plant in the Ukraine is fourth. In the future, the U.S.S.R. will be an important nickel exporter, based on both Soviet and Cuban concentrates.

The Norilsk complex in western Siberia produces copper, nickel, cobalt, platinum-group metals, selenium, and other rare metals, and recent expansion there has been rapid. In 1980, production of nickel at Norilsk is to be increased almost 80% over that of 1975; a substantial part of the increase is to come from the Nadezhda complex, which is under construction. About 50% of the ore production will come from the Oktyabr'skiy mine. Prospecting is being carried out north of Norilsk. With a total population of 210,000 in the city in January 1977, the Norilsk complex employed about 100,000.

One open pit (Medvezhiy Ruchey) and one underground mine (Zapolyarnyy) operate at the Norilsk sulfide deposit, where the ore averages 0.5% nickel, 0.75% copper, and up to 0.35 troy ounce per ton platinum-group metals (mainly palladium and platinum). Two underground mines (Mayak and Komsomol'skiy) operate at the Talnakh deposit, where ores average about 1.5% nickel, 3% copper, and up to 0.35 troy ounce per ton platinum-group metals. Three stages of the Oktyabr'skiy underground mine were in operation at the Oktyabr'sk deposit, where ores average 3.65% nickel, 4.7% copper, and 0.13% cobalt and are associated with platinum-group metals. The fourth stage of this mine is under development. Full planned capacity is to be reached in four stages by 1980. The Oktyabr'skiy mine is the largest underground mine in the Soviet nonferrous metals industry and is to produce 50% of the total ores at Norilsk in 1980. The Kola Peninsula copper and nickel enterprises are supplied partially with ore from Norilsk. In the future, these deliveries are to be increased.

There was one concentrator in operation at the Norilsk complex, and a second was under construction in 1976. Sinking of the 1,500-meter-deep Taymyr shaft started in April, and construction of the third Messoyakha-Norilsk gas pipeline began in November 1976.

Construction of the 1-billion-ruble Nadezhda metallurgical complex at Norilsk, a major project of the tenth 5-year plan, continued with the technical assistance of Finnish companies. Over 5,000 workers were employed in construction of this project in May, and the number was to be doubled by yearend. The complex is to consist of 15 plants and is to produce copper, nickel, cobalt, and platinum-group and rare metals; the first stage, originally scheduled for completion in 1974, has been rescheduled for 1977. The autoclaves to be used here are the first in Soviet nonferrous metallurgy.

Because of the complex ores and the need for time to develop improved concentration technology, the first stage of the Nadezhda complex is expected to operate at less than desired productivity. Consumption of reagents is expected to be high, nickel in concentrates is expected to be low (10% to 12%), and large losses of cobalt (up to 40%) and platinum-group metals are expected.

Construction of the Norilsk-Nadezhda railroad complex (around 30 kilometers) was completed in November. Laying of the 35-kilometer pipeline for concentrate shipment from the mill to this complex began in 1976 and is scheduled for completion in 1980.

Monchegorsk ore averages about 0.7% nickel and 0.4% copper and contains some cobalt and precious metals. At the Lovnozersk deposit, ore values average 0.9% nickel, 6.5% copper, and 0.04% cobalt, in association with some precious metals. The ores at the Severonikel complex at Monchegorsk are mined by both open pit and underground methods. The Zhdanov complex is the largest operation in this area. Four small underground mines (Kaula, Kotselvaara, Kammikivi, and Northern) and two small open pits (Kaula and Kammikivi) were in operation at the Pechenganikel complex. Three mills of the second stage of the No. 1 ore-dressing plant at the Pechenganikel complex were put into operation at the end of 1976. Enlargement and renovation of concentrators and smelters continued. A No. 2 smelter with the same capacity as the existing unit is planned.

The port of Murmansk continued to carry Norilsk ore for the Severonikel complex in 1976. During the 7 to 8 months of the navigation season, some 200,000 tons of ore was shipped. In the future, shipments are to be increased. The metal content of the Norilsk ore shipped to the Kola Peninsula enterprises was 3.1% to 3.5% nickel, 2.8% to 3.2% copper, 0.11% to 0.14% cobalt, and some precious metals.

During 1971–76, the Yuzhuralnikel complex was renovated and its output was increased about 16%. A total of over 112 million rubles was invested. The 20-ton converters (2.3 meters in diameter and 5.54 meters long) were replaced by 30-ton units (2.8 meters in diameter and 6.1 meters long). Development of the first stage of the Shcherbakovskiy open pit, the largest in the Kimpersay nickel ore administration of the Yuzhuralnikel complex, was completed in December. In 1977, this stage is to produce 0.5 million tons of ore, and the pit, which will supply the Yuzhuralnikel plant, is to be fully operational by the end of 1980. A small open pit was put into production at the Buruktal nickel deposit in May. The ore, with an average of 0.88% nickel and 0.08% cobalt, is smelted in an electric furnace.

The U.S.S.R. was financing a $600 million expansion of Cuban nickel production, with output of 90,000 tons per year scheduled for 1985. Two existing plants (Nikaro and Moa) are to be renovated, and a new plant (Punta Gorda), with an annual capacity of 30,000 tons of nickel plus cobalt, was under construction in 1976.

It was reported that the U.S.S.R. will import nickel from the Philippines in repayment for Philippine purchases of Soviet goods.

Platinum-Group Metals.—The U.S.S.R. remains the world's largest producer and exporter of platinum-group metals, supplying 20% to 25% of international exports of platinum and more than 50% of world consumption of palladium and rhodium. The U.S.S.R. is steadily expanding its output of platinum-group metals; the estimated output was 2.8 million troy ounces in 1976, about 6% over that of 1975. Reserves are adequate to maintain production and increased exports for many years. In 1975, it was planned to increase production of platinum-group metals at Norilsk 60% over 1970 levels. The 1976–80 plan calls for platinum-group metals output at Norilsk to rise about 80% over that of 1975. Soviet primary production is forecast to increase at an annual rate of 4% to 5%. Production of platinum-group metals may reach 2.95 million troy ounces in 1977.

Production of platinum-group metals comes principally from the Norilsk copper and nickel complex in western Siberia, the Severonikel and Pechenganikel complexes on Kola Peninsula, and several small placer deposits in the Urals. Virtually all platinum-group metals were produced as byproducts, with about 75% coming from Norilsk. The high priority given to the Norilsk development suggests that the Soviets are determined to proceed with increased production of platinum-group metals despite high costs imposed by the harsh northern climate. Expansion is expected to accelerate in a few years, with the completion of the Oktyabr'skiy underground mine and No. 2 concentrator. The mine has been under development since 1969 and is scheduled for completion in four stages by 1980.

Silver.—Output of silver was estimated at 44 million troy ounces, 2.3% above that of 1975. Almost all silver is produced as a byproduct of nonferrous metals operations, with production centered mainly in the Soviet Far East, eastern Siberia, the Urals, Kazakhstan, and Armenia. During the year, 14 gold treatment plants also extracted silver. The Norilsk complex in western Siberia and some of the Kola Peninsula copper-nickel

enterprises also produced silver. In 1976, production of silver increased at the Gaysk complex in the Urals.

Recovery of silver at beneficiation plants in the Urals ranged from 15% to 20% from complex ores containing 0.2 to 0.5 troy ounce per ton silver. It is planned to organize production of silver in Armenia, using the Zod, Gey-Lirkvaz, Megradzor, and Shaumyan deposits. All nonferrous metals enterprises in Armenia recover very small amounts of silver from copper-molybdenum ores.

Tin.—Although Soviet policy has emphasized self-sufficiency, tin output continued to be inadequate, and about one-fourth of requirements had to be imported in 1976. Primary tin production in 1976 was estimated at 31,000 tons, 3.3% over that of 1975. The Soviet Far East, Yakutia, and Transbaykal were the main tin producing areas. In 1976, over 25% of total output was from placers, and the Soviet northeast placers accounted for 75% of this. Maritime Territory is the largest producer, and the Khrustal'nyy complex, which operates both lode and placer deposits, is the largest enterprise there.

The Khrustal'nyy complex operated the Khrustal'nyy, Ege-Khaya, Imeni Lazo, Kholodnyy, and Alyaskitovyy mines in 1976. The Ternistyy and Arsen'evskaya mines of this complex, which were scheduled for completion in 1975, were under development in 1976 and were rescheduled for completion by 1980. A major overhaul of the concentrator at the Iul'tin complex in Magadan Oblast was not completed on time, causing tin production at this complex to fall short of goals in 1976. Construction of small tin and copper smelters at Solnechnyy in this region began in 1976, with completion scheduled for 1980. When the smelters go into service, tin and copper concentrates will no longer be shipped for further treatment.

The first Soviet unit to extract tin from cassiterite ore tailings was put into operation at the Khinganolovo (Khingan tin) complex at Birobidzhan (Jewish Autonomous Oblast), Khabarovsk Kray, in June 1976. Mining of a small tin deposit at this complex began in April.

Three known tin refineries were operating in the U.S.S.R. in 1976: Novosibirsk, Ryazan, and Podolsk (near Moscow). At the Novosibirsk plant, which is the largest in the U.S.S.R., the No. 3 furnace was put into operation in May. The Ryazan refinery began treating all types of concentrates and secondary sources of tin in 1976. Output of secondary tin in 1976 was estimated at 11,000 tons, 10% above that of 1975. Construction of a tin-processing unit began at the Rustavi secondary nonferrous metals plant in Georgia in 1976.

Reportedly, the U.S.S.R. is to provide technical plans for the second low-grade tin volatilization plant to be built in the area of Machaçamarca, Bolivia.

Titanium.—Titanium production in 1976 was estimated at 32,000 tons, 6.7% over that of 1975. Development of the titanium industry continues to be based mainly on Ukrainian and Siberian ilmenite and rutile. Reports indicated that a titaniferous slag containing 83% titanium dioxide was being produced at the Zaporozhye plant in the Ukraine. During the 1971–75 period, a 40% planned expansion was almost met. The tenth 5-year plan for development of the titanium-magnesium industry will be devoted to renovation of equipment at the existing plants. Production of titanium is programmed to be raised 40% in the 1976–80 period. Estimated output for 1977 and 1980 is 35,000 tons and 42,000 tons, respectively.

During the ninth 5-year plan, output of titanium sponge at the Berezniki complex increased 43.5%; the planned increase for 1976–80 is 34.4%. It is planned to increase production of titanium at the Ust-Kamenogorsk complex in Kazakhstan 8.6% in 1977 over the 1976 output.

With the forthcoming expansion of Soviet titanium production, exports of titanium sponge are to be increased significantly. Reportedly, West Germany's Fried. Krupp GmbH will import Soviet titanium. The price of Soviet titanium sponge for the first half of 1976 was around $2.45 per pound, approximately 11% below the price charged for deliveries in the second half of 1975.

Tungsten.—The estimated production of 8,000 tons of tungsten in concentrate was insufficient for growing domestic needs, and about one-third of requirements had to be imported. The industry continued to be centered mainly in the North Caucasus, Transbaykal, the Soviet Far East, Soviet Central Asia, and Kazakhstan. Production is estimated at 8,200 tons in 1977 and 8,700 tons in 1980. Consumption of tungsten by

the Soviet steel industry is much higher than that by the ceramic hard alloys industry. The 1976–80 5-year plan calls for special attention to be given to exploration for tungsten deposits.

The main producer of tungsten concentrates is the Tyrny-Auz tungsten and molybdenum complex in the North Caucasus, where both underground and surface methods are used.

The capacity of the Ingichinsk tungsten concentrator in Uzbekistan, which was put into operation in 1973, is some 25% greater than the capacity of mines supplying the plant. As a result, the concentrator reportedly was idle for considerable periods, and the recovery of tungsten in concentrate was much below the planned level of 87.5%. At the Vostok-2 tungsten mine in Maritime Territory, a concentration mill was under construction in 1976. Exploration of the Lermontovskoye deposit in this region continued in 1976.

Vanadium.—The U.S.S.R., with large vanadium resources, is becoming an important producer and exporter. The principal sources of vanadium continued to be slag from smelting titaniferous magnetite from Kachkanar open pits in the Urals and iron ore from Lisakovsk (0.06% vanadium) in Kazakhstan. The Nizhniy Tagil metallurgical complex and the Chusovskoy metallurgical plant in the Urals are the enterprises in the U.S.S.R. that produce raw material for the production of vanadium and its alloys. Nizhniy Tagil, where the vanadium slag is produced from 130-ton oxygen converters, is the only modern enterprise. The vanadium content of the pig iron at the Chusovskoy plant is 0.54%, and that at the Nizhniy Tagil complex is 0.44%. After devanadization of the pig iron, the average V_2O_5 content of the slag at the Chusovskoy plant is 17.2% and that at the Nizhniy Tagil complex is 21.2%.

The growth of vanadium output depends on developing the titanomagnetites, located chiefly in the Urals. The feasibility of processing these ores is determined by the integrated utilization of iron and vanadium. The construction of the Kachkanar iron ore mining and concentration complex and the processing of vanadium at the Nizhniy Tagil metallurgical complex has made it possible to increase output of vanadium products considerably.

It is planned to develop the Kachkanar No. 2 unit and to increase production of vanadium in the future. It is also planned to construct special units at some alumina plants to recover V_2O_5 as a byproduct of bauxite and other raw materials.

Minor Metals.—The U.S.S.R. possesses commercial deposits of all the rare metals that have assumed importance in modern rocketry, aircraft, and nuclear energy. The main deposits are in Kazakhstan, Kola Peninsula, Uzbekistan, Armenia, the Urals, the Ukraine, Norilsk, Transbaykal, and the Soviet Far East.

Byproduct rhenium is recovered at the Balkhash and Dzhezkazgan complexes in Kazakhstan, the Kadzharan copper-molybdenum complex in Armenia, the hard-alloy plant in Uzbekistan, and some other plants.

Selenium and tellurium are extracted at electrolytic copper plants at the Balkhash complex in Kazakhstan, the Norilsk complex in eastern Siberia, and some other plants. In 1976, the Novosibirsk tin refinery started to recover indium from tin concentrates, and the Almalyk complex in Uzbekistan is recovering indium from zinc wastes. It is planned to begin recovery of gallium from bauxite and nepheline used to produce alumina by 1980.

NONMETALS

The U.S.S.R. produces a wide variety of nonmetallic minerals. However, the resource position varies from adequacy of many nonmetals to apparent shortages of others, such as barite, fluorspar, mica, and talc.

Asbestos.—The Soviet asbestos industry remains the largest in the world, with an estimated output of the seven grades at 2.29 million tons in 1976 (390,000 tons over that of 1975). Over 67% of total production came from the Uralasbest complex, about 28% from Dzhetygara in Kazakhstan, and 4% from the Tuvaasbest complex in Tuva A.S.S.R. Exports rose from 385,300 tons in 1970 to 613,300 tons in 1975, with about 60% going to Western markets. Despite the asbestos export expansion in recent years, the reported domestic deficit was expected to be 100,000 tons in 1976. Estimated output for 1977 and 1980 is 2.37 million tons and 2.52 million tons, respectively.

Development in the asbestos industry has been concentrated in the Urals, Kazakhstan, and Tuva A.S.S.R. Total output of the

seven grades of asbestos at the Uralasbest complex was estimated at 1.54 million tons. Three open pits at this complex produced 35 million tons of crude ore and moved and dumped over 91 million tons of overburden in 1976. It is estimated that mining of crude ore and overburden will be increased from 126 million tons in 1976 to about 150 million tons in 1980, but production of marketable asbestos is expected to remain unchanged at about 1.54 million tons because of the decreasing asbestos content of the ore. The old No. 3 concentrator, with an annual capacity of 120,000 tons of marketable ore, is now obsolete and is to be replaced by a new No. 7 plant.

In Kazakhstan, a large complex has been organized for developing the Dzhetygara deposit in Kustanay Oblast, which is the second largest installation in the U.S.S.R. The first mill at this complex, with an annual capacity of 200,000 tons, was commissioned in 1965. During 1971–75, this mill was renovated, and production increased from 259,000 tons in 1970 to an estimated 360,000 tons in 1976. The Dzhetygara No. 2 mill, with an annual capacity of 400,000 tons, was completed in 1975 and produced an estimated 290,000 tons in 1976. Total output at the Dzhetygara complex will be increased from 650,000 tons in 1976 to an estimated 760,000 tons in 1980. The first mill of the Tuvaasbest complex, with an annual design capacity of 25,000 tons, was put into operation in 1966. This mill produced an estimated 30,000 tons in 1976. The second mill at this complex, with a capacity of 195,000 tons per year, was commissioned in April 1976; estimated production from this mill was only 70,000 tons in 1976. Total output at Tuvaasbest will be increased from an estimated 100,000 tons in 1976 to 225,000 tons in 1980.

The Kiyembay asbestos deposit in Orenburg Oblast (Southern Urals) is to be the second of 10 joint investment projects (with a total value of 9 billion transferable rubles) approved under the CMEA's comprehensive program. It calls for a total contribution of 100 million transferable rubles from the six Eastern European member countries. In exchange, the U.S.S.R. will supply an equivalent value of asbestos over a 12-year period at CMEA "world prices." In terms of volume, this represents about one-half the planned production capacity for each of the 12 years of the agreement, which can be extended an additional 10 years beyond 1991.

Development of the Kiyembay deposit started in 1968 and continued in 1976. The design capacity is 500,000 tons per year of grades III to VI from 24 million tons of ore with an average grade of 4.4%. The complex is to be completed in two equal stages. The first is to be completed in 1979, and its output will be shared among the CMEA members according to the share contributed to the construction.

A breakdown of investment contributions and the annual tonnage of asbestos receivable when full production is reached in 1982 follows:

Country	Investment (million rubles)	Tonnage receivable (thousand metric tons)
Bulgaria	24.0	40
Czechoslovakia	8.4	14
Germany, East	24.0	40
Hungary	1.8	3
Poland	30.0	50
Romania	18.0	30
Total	106.2	177

In 1976, 14 prospecting teams were conducting a detailed study of a 20,000-square-kilometer area in Tuva A.S.S.R., mainly to search for resources of asbestos and cobalt. Examination of the Sayan asbestos deposit in this region was completed in 1976. Asbestos reserves estimated at 6 million tons are situated near the Usinskiy highway on the Krasnoyarsk Kray border, where an asbestos complex is to be built.

Barite.—Barite is mined by both open pit and underground methods, and at many operations crude output is concentrated by flotation. Estimated domestic production in 1976 totaled 400,000 tons, a 14% increase over that of 1975. About 60% of the country's barite consumption in 1976 was produced domestically; the balance was supplied by imports of high-grade barite mainly from North Korea, Yugoslavia, and Bulgaria. The main centers of production continued to be Georgia, western Siberia, and Kazakhstan. Construction of a 45,000-ton-per-year complex at Khaishi in Svanetia, Georgia, and development of the underground mine at the Zhayremsk polymetallic complex in Kazakhstan continued in 1976.

Diamond.—The U.S.S.R. continued to make rapid progress in expanding its dia-

mond industry, which is centered in Yakutia where about 20 deposits have been discovered. Production in this region started with one small plant in 1957. In January 1977, the industry consisted of the large Mirnyy open pit with five concentrators, the Udachnaya placer mine and concentrator (near the Arctic Circle), and the Irelyakh placer mine with two dredges. Small quantities of gem and industrial stones were produced from the Vishera River region placers in Perm Oblast, where four dredges and two separation plants were operated at two placers in 1976. In 1976, output was estimated at 7.9 million carats of industrial quality and some 2 million carats of gem quality. Production of diamond is estimated at a probable 10.1 million carats in 1977 and 10.7 million carats in 1980. Next to fossil fuels and precious metals exports, diamond accounts for the largest share of the U.S.S.R.'s overall foreign currency balance.

Gem stones are cut at Leningrad, Sverdlovsk, and Smolensk, where Belgian specialists have been employed. Sales of cut stones are rising steadily, and substantial increases are expected in 1977–80. The U.S.S.R. has arranged to market part of its diamond output in Antwerp through a newly formed Soviet-Belgian company in which the Soviet export organization Almazyuvelirexport has a controlling interest. The U.S.S.R. State Committee for Science and Technology signed an agreement with a Belgian company on scientific and technical cooperation in the production and use of diamond tools.

The first stage of the No. 12 concentrator at the Udachnaya diamond deposit in Yakutia has been approved for operation, and construction on the second stage began in 1976. The Yakutalmaz (Yakutia diamond) complex, the Aykhalalmaz (Aykhal diamond) enterprise, and the Yakutniiproalmaz research and design institute were reorganized into the Yakutalmaz Association in 1976. A substantial but unknown quantity of synthetic diamond was also produced in 1976 by plants in Moscow, Kiev, Yerevan, Tashkent, and Poltava.

Fertilizer Materials.—Production totaled about 22 million tons in nutrient content, or 92.3 million tons in gross weight,[22] an increase of 3% over that of 1975. This increase was obtained mainly through the commissioning of new capacities. In 1976, plant capacities were expanded by 7.3 million tons per year of fertilizers (Soviet standard), although the planned quota for construction of new facilities was not met. The average nutrient content increased from 29% in 1970 to 37% in 1976. It is estimated that nitrogen fertilizers constitute around 38%, potassium fertilizers 37%, phosphate fertilizers 21%, and phosphorite fines 4%.

The Soviet mineral fertilizer industry did not meet its production goals of 94.5 million tons for 1976. Eleven of the twenty-three plants operated by the Ministry of Chemical Industry failed to meet 1976 production quotas. Most plants also failed to attain design capacity in 1976. A published Soviet review of basic reasons for the prolonged leadtimes for new plants to attain planned capacity listed the following: Inadequacy in planning, turning over facilities for operation while substantial construction and installation work remains incomplete, equipment defects, inadequacies in raw materials and supply, and failure to secure qualified personnel. Because of the unsatisfactory conditions of the equipment at the Uvarovo double-superphosphate ammonium phosphate plants, the degree of capacity utilization was only 34.1% in 1974 and 42% in 1976.

Over 97% of the fertilizers were shipped by railroad, mostly in bulk, causing large losses, moisture penetration, and difficulties in loading and unloading. Deliveries were made to some 7,000 railroad stations where bulk unloading was done with manual labor. As a result, about 15% of the total fertilizers shipped are lost each year according to Soviet industry estimates. Because of the enormous losses of mineral fertilizers, the Communist party Central Committee and the U.S.S.R. Council of Ministers adopted a resolution on June 20, 1976, entitled "On Measures to Further Increase the Effectiveness of Mineral Fertilizers; to Reduce Their Loss During Transport, Storage and Application; and to Perfect the Agrochemical Services of Kolkhozes and Sovkhozes." The resolution primarily reflected a concern with shortcomings in the handling and use of fertilizers.

[22] The average content (nitrogen, phosphorus, and potash) is expressed in Soviet standard units. Nitrogen is expressed as ammonia sulfate at 20.5% nitrogen, phosphorus is expressed at 18.7% P_2O_5, potash is expressed at 41.6% K_2O, and ground phosphate rock (phosphorite fines) is expressed at 19% P_2O_5.

Growth of the Soviet mineral fertilizer industry has high priority with Soviet planners. The State plan envisages output (Soviet standard) of 98.5 million tons in 1977 and 143 million tons in bulk (32 million tons of nutrients) in 1980 (plus some 5 million tons to be used as chemical additives to fodder). Actual production for 1977 and 1980, however, is estimated at 97 million tons and 130 million tons, respectively. During the 1976–80 period, 55.4 million tons per year of new fertilizer capacity is to be commissioned. Ammonia capacity is to be increased by 13.4 million tons per year and sulfuric acid capacity by 10 million tons per year. In 1980, phosphorous fertilizers are to amount to 33.1% of the total output of mineral fertilizers, compared with 24.1% in 1970. Complex fertilizer production is to account for 88.3% of total output in 1980, compared with 77.8% in 1975, and average nutrient content is to reach 40%.

Five large ammonia plants (each with a 450,000-ton-per-year capacity) together have a capacity equal to about 17% of the national Soviet capacity in 1975. All of these plants (two at Novomoskovsk and the others at Novgorod, Nevinnomyssk, and Severodonetsk) were constructed by Toyo Engineering. According to the new 5-year plan, by 1980, over one-half of the total ammonia is to be produced by plants with a capacity of 400,000 to 450,000 tons per year. During the 1976–80 period, equipment for 23 new ammonia plants, each with a capacity of 450,000 tons, is to be supplied by Western companies. These plants will be constructed in the U.S.S.R. with the assistance of Toyo Engineering (15 plants), Chemico Engineering Co., Ltd. (4 plants), and Creusot-Loire (4 plants).

The following seven ammonia plants were under construction and scheduled for completion in 1976: Berezniki, Chernorech'ye, Ionava, Kuybyshev, Nevinnomyssk, Novokemerovo, and Severodonetsk. The other 16 ammonia plants, which are to be put into operation in 1978–79, are as follows: Cherepovets, Cherkassy, Dneprodzerzhinsk, Dorogobuzh, Gorlovka (2 plants), Grodno, Novgorod, Novomoskovsk, Odessa (2 plants), Rossosh', and Togliatti (4 plants).

An agreement between the U.S.S.R. and four CMEA nations was signed for the construction of the Kingisepp mineral fertilizer plant in Leningrad Oblast. Bulgaria, Czechoslovakia, Hungary, and East Germany have supplied the equipment and materials for this plant in exchange for Soviet deliveries of ammonium phosphate over 10 years, beginning in 1976. The ore contains only 6% to 7% P_2O_5 but is easily beneficiated. The first stage for the production of mono-ammonium phosphate at this plant was commissioned in 1974, and the second stage was under construction in 1976 and was rescheduled for completion in 1977.

Phosphate.—Estimated output of phosphate rock totaled 71 million tons in 1976, including 37 million tons of apatite ore (17.7% P_2O_5) and 34 million tons of sedimentary rock (13% P_2O_5). The main centers continued to be the Apatit Association on Kola Peninsula and the phosphorite deposits at Karatau in Kazakhstan. Deposits of phosphorites also occur in Upper Kama in the Urals, Egorevsk and Lopatino in Moscow Oblast, Kingisepp in Leningrad Oblast, and some other regions, but the P_2O_5 content is rather low. Generally, they produce phosphorite fines with about 19% P_2O_5.

The Khibiny apatite nepheline deposits are the largest single phosphate source. Mined ore averaging 16% to 21% is upgraded to 39.4% P_2O_5 with 92% recovery. The Apatit complex produced an estimated 15.9 million tons of concentrate (37 million tons of ore) in 1976 from three underground mines and one open pit, and it provided about 70% of all raw materials for the production of phosphatic fertilizers. New facilities with an annual capacity of 0.9 million tons of apatite ore were commissioned at the first stage of the Yukspor mine in 1976. During the year, the 27th section of the dressing plant with an annual capacity of 230,000 tons of concentrate was put into operation.

A new apatite deposit at Mount Koashva was assigned to the Apatit Association in 1973. The Koashva mine, with an annual capacity of 7 million tons of ore, was under development in 1976. The first stage of this mine is scheduled for completion in 1978 and will be linked to Kirovsk by rail. Construction of the experimental mill at the Zabaykal'sk complex in Buryat A.S.S.R. continued in 1976. Between 1977 and 1980 this mill is to begin experimental production of an apatite concentrate from the Oshurkovo deposit, where reserves are large but contain only 4% P_2O_5. In the future, the

Zabaykal'sk apatite complex, with an annual capacity of 1.3 million to 1.5 million tons of concentrate, is to be built. At the Kovdor iron ore complex on Kola Peninsula, an apatite concentrate plant, with a first-stage capacity of 880,000 tons, was commissioned in 1975; the second stage was under construction in 1976. It processes tailings from the iron ore concentration complex.

It is planned to produce 220 million tons of ore and 80 million tons of concentrate at the Apatit Association during the 1976–80 period. By 1980, annual production of apatite concentrate is to be raised to 18.2 million tons at the Apatit Association, plus 1.38 million tons at the Kovdor mining and concentration complex, which forms a part of the Apatit Association. During the 1976–80 period, new capacities for production of 15.4 million tons of apatite ore and 3 million tons of apatite concentrate are to be put into operation.

The 45 commercial deposits in the Karatau area of Kazakhstan contain 1,500 million tons of minable phosphorite. The five largest deposits, Dzhantas, Aksay, Chulaktau, Koksu, and Kokdzhone, contain more than one-half of the total reserves. Seven open pits at the Aksay and Dzhantas deposits and the Molodëzhnyy underground mine at the Chulak-tau deposit produced an estimated total of 9.6 million tons in 1976. About 6.7 million tons came from the Dzhantas deposit. The ore content ranges from 21% to 25% and was upgraded to 28.5% P_2O_5, but recovery was low. New facilities for the mining of 1.7 million tons of ore and 0.65 million tons of marketable products were put into operation at the Tsentral'nyy mine at yearend. It is planned to produce about 20 million tons of phosphorite in the Karatau area in 1980. During 1977–80, the following mines are to be commissioned: Kokdzhone (annual capacity of 4.75 million tons of ore), T'esay (annual capacity of 2 million tons), Koksu, Ur-Bas, Geres, Kis-Tas, and other small mines, with a total capacity of 20 million tons of ore and 13 million tons of marketable products.

The Voskresensk complex in Moscow Oblast produced over 2 million tons of phosphorite fines in 1976. Production of ground phosphate rock in the Verkhnekamsk phosphorite area reached about 500,000 tons in 1976 and is to increase 50% during 1976–80.

Potassium.—The U.S.S.R. is one of the world's leading countries in potassium ore reserves, potassic fertilizer output, and exports of potash salts. Estimated output (41.6% K_2O) was 20.5 million tons in 1976 or 8.5 million tons in nutrient content; this was about 7.3% higher than the 19.1 million tons (7.9 million tons in nutrient content) of 1975 and about 109% higher than the 9.8 million tons (4.1 million tons in nutrient content) of 1970. Under the 1976–80 plan, output of potash is to increase 35% over the 1975 level to 26 million tons (10.8 million tons in nutrient content). Estimated actual levels of potash output for 1977 and 1980, however, are 21.7 million tons and 25 million tons, respectively. The total output of the potassium mines in the U.S.S.R. exceeded 60 million tons of ore in 1976 and is to be increased to 85 million to 90 million tons by 1980.

Gross potash reserves are reported at 22,900 million tons of 16% to 40% nutrient content (3,800 million tons of K_2O). About two-third of the reserves are located in the Upper Kama Basin in the Northern Urals. The four major producing areas are Solikamsk and Berezniki (49.6% of the total) on the western side of the Urals, Soligorsk in Belorussia (43.6%), and Stebnikov (2.9%) and Kalush (2.7%) in Western Ukrainia. Some 1.2% of the total was produced by enterprises of the nonferrous metals industry. The following 10 complexes were in operation in 1976: Berezniki Nos. 1, 2, and 3; Solikamsk Nos. 1 and 2; Soligorsk Nos. 1, 2, and 3; and the first stages of the Novostebnikov and Kalush complexes.

In 1976, three complexes were under construction: The first stage of Soligorsk No. 4 in Belorussia, Berezniki No. 4, and Novosolikamsk in the Urals. By the end of the new 5-year plan, construction of Soligorsk No. 4, Berezniki No. 4, and Novosolikamsk are to be completed. It is also planned to enlarge Solikamsk No. 1 and Soligorsk No. 3 by 200,000 tons per year each and Berezniki No. 3 by 140,000 tons per year during 1977–80. The nutrient content of the concentrates is to be increased from 53% K_2O in 1975 to 58.1% K_2O in 1980.

Fluorspar.—Fluorspar output remained below domestic requirements despite efforts to achieve self-sufficiency. Imports of fluorspar from Mongolia, the People's Republic of China, Japan, and Thailand increased

from 144,700 tons in 1970 to 493,900 tons in 1975. Estimated levels of fluorspar output for 1976 and 1980 were 490,000 tons and 540,000 tons, respectively.

Maritime Territory (the Yaroslavsk deposit), Transbaykal (the Kalanguysk, Abagatuysk, and Usuglinsk deposits), Uzbekistan, and Kazakhstan were the main producing areas in 1976. The mined ore contained 20% to 45% CaF_2. Hand picking, classification, heavy media, and flotation methods are used for concentration. During the 1971–75 period, despite a deterioration in the CaF_2 content of the ore, extraction of CaF_2 at the Yaroslavsk concentrator increased 1.8%; that at Kalanguysk rose 5.1%, and that at Usuglinsk rose 4.4%. The Central concentrator in Uzbekistan, which treats ores containing 24.3% to 26.5% CaF_2, produced a 95% CaF_2 concentrate with about 85% recovery. The dressing mill in Maritime Territory treats ores containing an average of 40.5% CaF_2 with about 76% recovery in a 92% CaF_2 concentrate. Exploration of the Suppatash, Kengutan, and Shabres deposits continued in 1976.

Mica.—The domestic supply of mica was augmented by large imports, despite the increasing use of substitutes. Strategic-grade mica continued to be imported from India to meet special industrial demands. Imports of mica increased from 160 tons in 1968 to 498 tons in 1975. Estimated output of mica is 43,000 tons in 1976 and 47,000 tons in 1980.

Irkutsk Oblast continued to be the main supplier of muscovite mica; 75% of all muscovite deposits in the country are in Mamsko-Chuyskiy Rayon of Irkutsk Oblast. Over 1,500 veins have been discovered in this area, and 9 small underground mines were in operation in 1976.

The Irkutsk and Petrozavodsk mica factories are the largest in the U.S.S.R. Mica is also mined in Murmansk Oblast on Kola Peninsula, Karelia, and Yakutia. The Kovdor deposit of vermiculite in Murmansk Oblast is mined by both surface and underground methods. The average 38.2% vermiculite content of the ore is upgraded to 88% with recovery of about 64%. The capacity of the Kovdor concentrator is 56,000 tons per year of concentrate. It is planned to develop the Slyudyanoy Bor deposit in Karelia in the future.

Salt.—The U.S.S.R. is one of the world's leading countries in salt reserves, production, and exports. Production in 1976 was estimated at 14 million tons. It was originally planned to increase salt production from 12.4 million tons in 1970 to 14 million tons in 1975 and to 20 million tons in 1980. However, production reached only 13.7 million tons in 1975 and the revised production level for 1980 is 18 million tons. Exports increased from 293,600 tons in 1970 to 320,700 tons in 1975. Salt development is concentrated in the Donets Basin, the Urals, eastern Siberia, Armenia, and Western Ukrainia. The increase in production came mainly from the Iletsk mine in Orenburg Oblast and the Avansk mine in Armenia. The Donets Basin continued to account for over 40% of total output in 1976. Development of a new mine with an annual capacity of 2 million tons at Artemovsk in this region continued in 1976. The Nizhniy Baskunchak salt complex, with a capacity of 700,000 to 900,000 tons per year, was also under construction. Construction of the Verkhnekamsk salt complex in Perm Oblast and renovation of the Iletsk mine continued in 1976. Construction of the Mozyr salt complex in Belorussia, which began in 1974 based on rock salt deposits that lie at a depth of up to 700 meters, continued in 1976. The planned capacity of the complex is 360,000 tons per year. The survey of a rock salt deposit near Gusev in Kaliningrad Oblast was completed in 1976. The U.S.S.R. awarded a contract to Technimont for the engineering of the 270,000-ton-per-year Sterlitamak salt plant in Bashkiria. The plant will be based on Montedison technology and is due to start up in 1977.

Sulfur.—The U.S.S.R. has large reserves of relatively low-grade, high-cost sulfur. Estimated production of contained sulfur totaled 8.3 million tons in 1976, of which 3.8 million tons was recovered from pyrite, 2.5 million tons from native sulfur, and 2.0 million tons from other sulfur sources. Estimated total sulfur output for 1977 and 1980 is 9.5 million tons and 11 million tons, respectively. Elemental sulfur exports, mainly to CMEA countries, decreased from 464,000 tons in 1970 to 441,000 tons in 1975. Imports of sulfur increased from 216,700 tons in 1970 to 690,000 tons in 1975. The principal producers of native sulfur continued to be Rozdol (Western Ukrainia), Gaurdak (Turkmenistan), and the Volga group of the Kuybyshev sulfur complex,

which together produced the bulk of the country's requirements.

The dressing mills of all three complexes treat ore with a sulfur content of 8% to 40% and produce a flotation concentrate with a 70% to 85% sulfur content. Sulfur production by the Frasch process at the Gaurdak complex has increased rapidly since the No. 2 installation (100,000 tons per year) went into service in 1975. The No. 3 100,000-ton-per-year installation using the Frasch process at this complex was under construction in 1976. The Rozdol complex produced concentrates containing 72% to 75% sulfur from ore containing 22% to 23% sulfur. It is planned to recover 895,000 tons of sulfur from Orenburg sour gas in 1977. Agreements have been signed for the supply by Poland of three sulfuric acid production units to the U.S.S.R. with a capacity of 1,515 tons per day each. The U.S.S.R. has already purchased 25 sulfuric acid plants from Poland.

Talc.—The U.S.S.R. produced an estimated 440,000 tons of talc in 1976, 4.8% more than in 1975. In 1976, only the Onot mine in Irkutsk Oblast, with an annual capacity of 45,000 tons of talc, produced high-grade material. Despite large reserves and the development of new mines and beneficiation facilities, imports of talc from North Korea and Bulgaria increased from 44,900 tons in 1973 to 90,950 tons in 1975. Estimated levels of talc output for 1977 and 1980 are 460,000 tons and 520,000 tons, respectively.

The Miass and Shabrovsk deposits in the Urals and the Kirgiteysk deposit in Krasnoyarsk Kray were the major Soviet producers of low-quality talc in 1976. Some talc is mined from the Tetri-Mindorskoye and Kvashevskoye deposits in South Ossetia, Georgia. The raw material at the Onot deposit is shipped for processing to the Miass talc mill in the Urals. The Medvedevskoye talc deposit in Chelyabinsk Oblast was under development in 1976.

MINERAL FUELS

Estimated production of primary energy derived from fossil fuels, fuelwood, and hydroelectric and nuclear generation increased from 1,610 million tons standard coal equivalent (SCE) in 1975 to 1,670 million tons SCE in 1976. Output of primary energy from all sources in 1980 is to rise to over 2 billion tons SCE. The 1980 production of crude oil is to rise 27% over that of 1975, natural gas 51%, coal 11%, hydroelectrical power 48%, and nuclear power 233%. The share of petroleum and natural gas in total Soviet primary energy production increased from 65% in 1975 to 67.3% in 1976, while that of coal (anthracite, bituminous, and lignite) declined from 30.6% in 1975 to 28.7% in 1976. In 1980, the share of petroleum and natural gas in total energy production is to be about 69% and coal will supply about 27%, with 4% to be provided by other sources.

Estimated consumption of all types of primary energy in the U.S.S.R. increased from 1,405 million tons SCE in 1975 to 1,429 million tons SCE in 1976. The share of petroleum and natural gas in total Soviet primary energy consumption increased from 61.4% in 1975 to 63.3% in 1976, while that of coal declined from 33.6% to 32.1%. Total consumption of all types of primary energy in the U.S.S.R. is expected to be about 1,743 million tons SCE in 1980. Clearly there will be a trend toward greater use of oil in the future. However, it is expected that the U.S.S.R. will make great efforts to substitute coal and natural gas for petroleum in order to make the latter available for export.

Among the Soviet resources of other fuels and energy in 1976 were hydroelectrical power, nuclear energy, peat, oil shale, and fuelwood. Peat (fuel), oil shale, and fuelwood together accounted for 7.7% of total Soviet primary energy production in 1960, but by 1976 their aggregate share had fallen to an estimated 2.8%. There was, however, an absolute increase in the production of these commodities, a trend which is expected to continue into the future.

According to published long-term agreements between the U.S.S.R. and other nations and the trade objectives announced in the various CMEA countries' 1976–80 5-year plans, it has been estimated that fuel exports from the U.S.S.R. to market economy countries will be increased from 94 million tons SCE in 1975 to 125 million tons SCE in 1980. Some 75 million tons of crude oil and petroleum products, 12 million tons of coal and coke, and about 22.9 billion cubic meters of natural gas is to be exported to market economy countries in 1980.

In 1976, the U.S.S.R. produced 519.7 mil-

lion tons of crude oil including gas condensate, 712 million tons of run-of-mine coal and lignite, and 321 billion cubic meters of natural gas. Soviet long-range forecasts place the demand for raw coal and lignite at over 800 million tons in 1980 and 1 billion tons by the year 2000.

The estimated total primary energy balance of the U.S.S.R. for 1976 and 1980 is shown in table 4.

Table 4.—U.S.S.R.: Total primary energy balance, 1976 and 1980
(Million tons of standard coal equivalent [1])

	Total primary energy	Coal (bituminous, anthracite, lignite) and coke	Crude oil and petroleum products	Natural and associated gas	Peat (including agricultural)	Oil shale	Hydropower	Nuclear power	Fuelwood
1976: [2]									
Production	1,669.8	479.0	743.1	380.3	11.3	11.0	17.0	3.5	24.6
Imports	37.0	11.0	11.0	15.0	--	--	--	--	--
Exports	277.4	31.0	214.0	31.0	--	--	1.4	--	--
Apparent consumption	1,429.4	459.0	540.1	364.3	11.3	11.0	15.6	3.5	24.6
1980: [3]									
Production	r 2,044.5	r 545.0	r 893.0	520.0	15.7	12.8	25.0	8.0	25.0
Imports	46.7	13.0	15.7	18.0	--	--	--	--	--
Exports	347.8	36.0	250.0	60.0	--	--	1.8	--	--
Apparent consumption	r 1,743.4	r 522.0	r 658.7	478.0	15.7	12.8	23.2	8.0	25.0

r Revised.
[1] 1 ton standard coal equivalent (SCE)=7,000,000 kilocalories.
[2] Actual.
[3] Forecast.

Coal.—In 1976, the U.S.S.R. produced 711.5 million tons of run-of-mine bituminous coal, anthracite, lignite, and brown coal, the equivalent of an estimated 408 million tons of clean coal according to Western practice, placing it second among world coal producers. This was over 10 million tons (or 1.5%) more than was produced in 1975. In the U.S.S.R., coal output is recorded on a ton-for-ton basis of unbeneficiated coal.

New facilities with an annual capacity of 12.6 million tons of run-of-mine coal and lignite were commissioned during the year. Construction of new projects continued to be slow, expensive, and frequently below established Western professional standards. At many mines, construction schedules were twice as long as plan specifications. Many new coal mines did not reach their planned capacity in 1976. Some of them have been lagging behind their annual targets for many years. Of 50 new and renovated mines in the Donets coal basin in the past 10 years, 38 had not attained their capacities, according to industry reports.

Gross production of the U.S.S.R.'s 10 major and numerous minor coalfields amounted to an estimated 470 million tons of bituminous coal, 78 million tons of anthracite, and 163.5 million tons of brown coal and lignite. About 32.6% of the total output was surface-mined.

Production in 1976 of raw coal and lignite in the major areas was as follows, in million tons: Donets Basin, 223.7; Kuznetsk, 138.9; Karaganda, 47.4; Moscow, 30.9; Kansk-Achinsk, 29.1; Pechora, 25.8; and other areas, 215.7.

The following coal-producing associations reported enterprises not fulfilling targets: Intaugol', Pervomayskugol', Prokopyevskugol', Kuzbassugol', and Sverdlovskantratsit. No rise in the average productivity of labor was attained for enterprises in the Ukraine. In such associations at Makeyevugol' and Dobropol'ugol', there was even a decline in labor productivity from that of 1975.

Production of raw coal and lignite is planned to rise to 733 million tons in 1977 and 750 million tons in 1980. In the 1976–80 period, 17 coal beneficiation plants with a total annual capacity of 57 million tons of raw coal are to be constructed or renovated. Development of the Ekibastuz,

Kansk-Achinsk, and southern Yakutia coal basins will be accelerated. It is planned to increase production of coal and lignite in this period by 28.2 million tons at Ekibastuz, 24.8 million tons at Kuznetsk, 14.4 million tons at Kansk-Achinsk, 11.8 million tons at Donetsk, and 7.5 million tons at Pechora. The share of surface coal mining is to be about 35% by 1980.

Soviet coal and coke statistics are presented in table 5.

Table 5.—U.S.S.R.: Salient coal and coke statistics [1]

(Million metric tons)

	Actual					Forecast
	1960	1965	1970	1975	1976	1980
Coal:						
Domestic output:						
Run-of-mine coal [2]	509.6	577.7	624.1	r 701.3	711.5	r 750.0
Clean coal [3]	306.0	331.0	357.0	r 400.0	408.0	r 427.0
Imports [4]	4.7	6.7	7.1	9.8	9.4	r 11.0
Exports:						
Centrally planned economy countries	8.2	15.2	14.8	16.8	17.1	19.0
Market economy countries	4.1	7.2	9.7	9.3	9.8	11.0
Total	12.3	22.4	24.5	26.1	26.9	30.0
Apparent consumption:						
Run-of-mine coal [2]	502.0	562.0	606.7	r 685.0	694.0	r 731.0
Clean coal [3]	298.4	315.3	339.6	r 383.7	390.5	r 416.0
Coke:						
Domestic output	56.2	67.5	75.4	r 83.6	84.8	r 93.0
Imports [4]	.7	.7	.7	r.9	.9	1.0
Exports:						
Centrally planned economy countries	2.2	2.8	3.2	3.2	3.2	r 4.0
Market economy countries	.4	1.0	.9	1.0	1.0	1.0
Total	2.6	3.8	4.1	4.2	4.2	r 5.0
Apparent consumption	54.3	64.4	72.0	r 80.3	81.5	r 89.0

r Revised.

[1] Production data are from: National Economy of the U.S.S.R., Moscow. 1960, 1965, 1970, and 1975; and Ugol' (Coal), Moscow. No. 4, 1977, p. 67. Trade data are from: Vneshnyaya torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. 1960, 1965, 1970, 1975, and 1976.

[2] As reported in Soviet sources.

[3] Estimated in accordance with Western practice and experience.

[4] All from centrally planned economy countries.

Electrical Power.—Total electrical power generation in 1976 amounted to 1,111 billion kilowatt-hours, a 7% increase over that of 1975. Electrical power generation is planned to rise to 1,160 billion kilowatt-hours in 1977 and 1,207 billion kilowatt-hours in 1978.

At yearend, the total installed capacity of Soviet electric powerplants reached 228 million kilowatts, of which 43 million kilowatts (18.9%) represented hydroelectric capacity and about 6.5 million kilowatts (2.9%) was nuclear capacity. Most of the future development of electrical power capacity will be centered on new thermal powerplants, most of which will be fueled by lignite. There were plans to commission 12.19 million kilowatts of new electrical power generating facilities in 1976, comprising 8.48 million kilowatts thermal, 1.01 million kilowatts nuclear, and 2.7 million kilowatts hydroelectric capacity. Only 11.9 million kilowatts, however, was actually commissioned during the year. Under the 1976–80 plan, 71 million kilowatts of new electrical power generating facilities are to be commissioned and are scheduled to produce 1,380 billion kilowatt-hours of electrical power annually by 1980. The output of hydroelectrical power may reach 212 billion kilowatt-hours by 1980. In 1980, the capacity of hydroelectric powerplants may reach approximately 56 million kilowatts. Capital investment in construction of new powerplants for the next 5 years has been set at a level of 26 billion rubles, compared with 22 billion rubles under the 1971–75 plan.

Exports of electrical power rose from 11.3 billion kilowatt-hours in 1975 to 11.6 bil-

lion kilowatt-hours in 1976 and included over 10 billion kilowatt-hours to centrally planned economy countries and over 1.5 billion kilowatt-hours to Finland and Norway. Hungary remained the principal importer of Soviet electrical power, followed by Bulgaria, Czechoslovakia, and Poland. Under long-term contracts, the U.S.S.R. will export some 15 billion kilowatt-hours of electrical power annually by 1980, including some 2 billion kilowatt-hours to Finland and Norway. Hungary is expected to remain the principal importer of Soviet electrical power until 1980. After 1980, the U.S.S.R. will deliver some 4 billion kilowatt-hours to Finland annually.

About 85% of all Soviet electrical energy is generated at thermal power stations, fueled mainly by lignite, as indicated, in percent, in the following tabulation:

Source of fuel	1965	1970	1975	1980 [e]
Coal and lignite	60.0	48.6	43.0	45.0
Mazout	11.5	23.0	29.5	28.0
Natural gas	22.1	23.1	22.1	22.0
Peat, oil shale, other	6.4	5.3	5.4	5.0

[e] Estimate.

Source: Elektricheskiye stantsii (Electric Powerplants), Moscow. No. 1, January 1975, p. 3; and No. 6, June 1976, p. 5.

Coal and lignite will continue to play a leading role in electrical power generation in the foreseeable future, and the share of coal- and lignite-fueled electrical power generation is to increase. Up to 75% of the solid fuels burned at the U.S.S.R.'s thermoelectric powerplants has a calorific value of 1,500 to 5,500 kilocalories per kilogram (2,650 to 9,850 Btu per pound).

About one-half of the total capacity of hydroelectric power stations of the U.S.S.R. is concentrated at plants with a capacity of over 1 million kilowatts. The largest operating station is the Krasnoyarsk Kray hydroelectric powerplant with a capacity of 6 million kilowatts.

Consumption of power by major branches of the Soviet economy in 1975 is shown in the following tabulation:

Consumer	Billion kilowatt-hours	Percent of total
Industry	582.0	56.2
Powerplants and losses	151.6	14.7
Domestic (urban)	123.5	11.9
Transportation	74.4	7.2
Agriculture and rural population	72.5	7.0
Construction	20.0	1.9
Exports	11.0	1.1
Total	1,035.0	100.0

Source: Elektricheskiye stantsii (Electric Powerplants), Moscow. No. 1, January 1976, p. 2.

Hydroelectrical Power.—The economic-technical potential of hydroelectrical power in the U.S.S.R. was placed at 1,095 billion kilowatt-hours per year. In the overall energy economy of the U.S.S.R., however, water power is of relatively small significance. Hydroelectrical power supplied 135 billion kilowatt-hours, or 12.2% of all electrical power generated in 1976.

Nuclear Energy.—At the beginning of 1976, the U.S.S.R. was operating eight atomic powerplants with a total capacity of 5,076 megawatts, or about 2.3% of the total capacity of all electric powerplants, as follows: Leningrad (two reactors, total capacity of 2,000 megawatts), Novo-Voronezh (four reactors, 1,455 megawatts), Kola Peninsula (two reactors, 880 megawatts), Shevchenko (one reactor, 350 megawatts), Beloyarsk (two reactors, 300 megawatts), Melekess (one reactor, 50 megawatts), Bilibino (three reactors, 36 megawatts), and Obninsk (one reactor, 5 megawatts). In December 1976, the following nuclear powerplants were put into operation: The fourth stage (one reactor) at Bilibino with a capacity of 12 megawatts, the first stage (one reactor) at Armenia with a capacity of 405 megawatts, and the first stage (one reactor) at Kursk with a capacity of 1,000 megawatts. Thus, the total installed capacity of the 10 Soviet nuclear powerplants at yearend was 6,493 megawatts, or 2.8% of the total capacity of all electric powerplants in the U.S.S.R.

In 1976, Soviet nuclear powerplants generated over 25 billion kilowatt-hours (25% more than in 1975), or 2.2% of all power supplied in 1976. Several nuclear powerplants were under construction in 1976, some of which were scheduled for completion by 1980. Plans are to install 13,750 megawatts of new nuclear capacity by 1980, although actual new capacity is estimated at only 10,920 megawatts, bringing the 1980 total to an estimated 15,000 to 17,400 megawatts. Although plans are to generate 80 billion kilowatt-hours of nuclear energy in 1980, the U.S.S.R. will probably increase its production to only 50 billion kilowatt-hours. Nuclear energy output is to represent about 3.6% of national electrical power production and 0.4% of total Soviet primary energy output by 1980.

According to Soviet sources, construction and initial fueling of nuclear power stations is more expensive than that of conventional thermal powerplants of similar capacity. However, operating costs at nuclear power stations are being constantly reduced, particularly at the large-capacity stations. The generation cost of 1 kilowatt-hour at the Novo-Voronezh nuclear powerplant was reduced from 0.95 ruble in 1971 to 0.65 ruble in 1975.

Soviet nuclear energy capacity is presented in the following tabulation:

Nuclear plant and unit	Startup date	Yearend capacity (megawatts)	
		Actual 1976	Estimated 1980
Obninsk	1954	5	5
Beloyarsk No. 1	1964	100	100
Beloyarsk No. 2	1967	200	200
Beloyarsk No. 3	--	--	600
Novo-Voronezh No. 1	1964	210	210
Novo-Voronezh No. 2	1970	365	365
Novo-Voronezh No. 3	1971	440	440
Novo-Voronezh No. 4	1972	440	440
Novo-Voronezh No. 5	--	--	1,000
Melekess	1965	50	50
Shevchenko No. 1 [1]	1973	350	350
Bilibino No. 1	1973	12	12
Bilibino No. 2	1975	12	12
Bilibino No. 3	1975	12	12
Bilibino No. 4	1976	12	12
Kola Peninsula No. 1	1973	440	440
Kola Peninsula No. 2	1974	440	440
Kola Peninsula No. 3	--	--	440
Armenia No. 1	1976	405	405
Armenia No. 2	--	--	440
Leningrad No. 1	1974	1,000	1,000
Leningrad No. 2	1975	1,000	1,000
Leningrad No. 3	--	--	1,000
Leningrad No. 4	--	--	1,000
Kursk No. 1	1976	1,000	1,000
Kursk No. 2	--	--	1,000
Kursk No. 3	--	--	1,000
Kursk No. 4	--	--	1,000
Smolensk No. 1	--	--	1,000
Chernobyl' No. 1	--	--	1,000
Rovny No. 1	--	--	440
South Ukrainian No. 1	--	--	1,000
New capacity		1,417	10,920
Total capacity		6,493	[2] 17,413

[1] The first dual-purpose nuclear powerplant using a sodium-cooled fast reactor with a design capacity of 150 megawatts and desalination capacity of 120,000 cubic meters per day of fresh water.
[2] Figure differs from that given on table 6 owing to a difference in source.

A major 5-year nuclear power expansion program is placing greater emphasis on nuclear energy in the Soviet energy balance. The reactors are to be installed in 10 new 1,000-megawatt-capacity nuclear powerplants to be built under the 1976–80 plan. The standard nuclear reactor now being produced at the Izhorsk plant in Leningrad is a 440-magewatt pressurized-water reactor. Using this model, the U.S.S.R. can turn to the West for the supply of equipment, technology, and know-how for its nuclear industry. The Soviets are interested in key components and equipment to be manufactured in Western Europe, Japan, and the United States.

The U.S.S.R. has meanwhile embarked on a program to develop its own reactor-

equipment-building facilities. The key to this program is the establishment of a very large reactor production plant near Volgodonsk on the River Don. The new complex, to be known as Atommash ("atomic machines"), will specialize in assembly line production of 1,000-megawatt reactors and other equipment for nuclear powerplants. The first stage of the plant is to be on-stream by November 7, 1977, and completion is scheduled for 1980. However, according to Soviet sources, problems have been encountered in construction of the Atommash plant,[23] including housing of the more than 16,000 construction workers on the project in 1976.

The U.S.S.R. provides technical assistance in the construction of nuclear powerplants in CMEA countries. In December 1972, the first Czechoslovak nuclear powerplant, with a capacity of 140 megawatts, was put into operation at Jaslovske Bohunice in West Slovak Region, with the aid of Soviet engineers. The second stage of this plant was under construction in 1976. The first stage (440 megawatts) of the Kozloduy nuclear powerplant in Bulgaria was completed in 1975, and the second stage, with the same capacity, is to be put into operation in 1977. Construction of similar nuclear powerplants, with a capacity of 440 megawatts each, began in Hungary (Paks) and Romania in 1974, scheduled for completion by 1985. The aggregate capacity of nuclear powerplants operating in CMEA countries was about 7,500 megawatts in 1976.

The first nuclear powerplant in Poland, with a capacity of 440 megawatts, is to be built on Lake Zarnowieckie, Gdánsk Province, during the 1990's. Cuba's first atomic power station is to built in Las Villas Province with Soviet assistance. The U.S.S.R. is to supply equipment for the plant, and the generating capacity of its first stage is to be 440 megawatts.

The first stage of the Loviisa nuclear powerplant in Finland, with a capacity of 440 megawatts, was under construction with Soviet assistance in 1976. Under a Finnish-Soviet agreement, the main machinery, reactor units, and turbines, as well as the nuclear fuel, will be delivered by the Soviet foreign trade organization Atomenergoexport. The Finns are responsible for the actual construction work as well as for the delivery of various components and electrical equipment. Reportedly, 750 Soviet engineers, technicians, and mechanics working on the nuclear powerplant have been living at the construction site. An agreement has been signed by the U.S.S.R. and Finland concerning the enrichment of uranium for the Olkiluoto nuclear powerplant.

According to a long-term agreement, Spain will import an estimated $400 million worth of Soviet uranium concentrate to fuel its nuclear powerplants. Reportedly, Rheinisch-Westfälisches Elektrizitätswerk AG (RWE) of West Germany has a contract with the U.S.S.R. worth DM1 billion and valid until 1990 that will insure a sufficient supply of uranium for the country's nuclear powerplants. A contract for the enrichment of uranium for Austria's second nuclear power project for a 12-year period was signed by the U.S.S.R. on May 23. This nuclear powerplant is scheduled for operation in 1980 or 1981. Reportedly, uranium will be enriched for Spanish nuclear powerplants by the Soviet firm Tekhsnabeksport between 1978 and 2000.

Electrical power generation and the year-end capacity of Soviet powerplants, by type, are shown in table 6.

[23] Sotsialisticheskaya industriya (Socialist Industry), Moscow. Sept. 2, 1977.

Table 6.—U.S.S.R.: Salient electrical power statistics

Type of powerplant	1970				1976				Forecast 1980			
	Yearend capacity		Production		Yearend capacity		Production		Yearend capacity		Production	
	Million kilowatts	Percent	Billion kilowatt-hours	Percent	Million kilowatts	Percent	Billion kilowatt-hours	Percent	Million kilowatts	Percent	Billion kilowatt-hours	Percent
Thermal	124.8	75.1	607.0	81.9	169.5	74.3	942	84.8	204	72.1	1,112	80.6
Hydroelectric	31.4	18.9	124.4	16.8	43.0	18.9	135	12.2	56	19.8	212	15.4
Nuclear	.9	.6	3.5	.5	6.5	2.9	25	2.2	15	5.3	50	3.6
Diesel and other	9.0	5.4	6.0	.8	9.0	3.9	9	.8	8	2.8	6	.4
Total	166.1	100.0	740.9	100.0	228.0	100.0	1,111	100.0	283	100.0	1,380	100.0

Sources: Elektricheskiye stantsii (Electric Powerplants), Moscow. No. 1, January 1976, p. 2; and No. 6, June 1976, pp. 2–8.
National Economy of the U.S.S.R., Moscow. 1975, p. 215.

Natural Gas.—The U.S.S.R. is among the world's largest producers and consumers of natural gas and is a net exporter of this commodity. In 1976, the U.S.S.R. produced 321 billion cubic meters of usable gas, 11% more than in 1975, exceeding the planned target of 313 billion cubic meters. Of this quantity, over 99% consisted of natural and oil-associated gas, and less than 1% was gas from gasification of coal and oil shale. In 1976, natural gas accounted for 22.8% of Soviet primary energy production and 25.5% of primary energy consumption. Of 5,000 wells in more than 650 gas, gas condensate, and gas-oil fields in 1976, 15% to 20% were idle. For the first time since 1956, the gas industry was able to meet its original annual production goal.

The 1976 extraction of gas in the main regions, in billion cubic meters, was as follows:

Region	Quantity	Percent change from 1975
Ukraine	68.7	--
Turkmenistan	62.6	+21
Western Siberia	47.8	+34
Uzbekistan	36.0	−3
Orenburg Oblast	31.8	+59
Komi A.S.S.R	19.6	+6

Source: Ekonomicheskaya gazeta (Economic Gazette), Moscow. No. 6, February 1977, p. 2.

The recovery of associated gas rose from 22.9 billion cubic meters in 1970 to 28.6 billion cubic meters in 1975. Significant losses of associated gas were encountered in many oil-producing regions. It was planned to carry out a number of important measures for increasing the effectiveness of utilization of associated gas, which rose from 61.6% in 1970 to 85% in 1975. The extraction target for 1975 had been set at 41.5 billion cubic meters in 1970; actual production, however, reached only 28.6 billion cubic meters. In 1976, the utilization of associated gas was only 64.9%, according to trade journal reports.

Production of natural and oil-associated gas, in billion cubic meters, was as follows:

	1970	1971	1972	1973	1974	1975
Natural gas	175.0	187.4	195.7	209.8	232.9	260.7
Oil-associated gas	22.9	25.0	25.7	26.5	27.7	28.6
Total	197.9	212.4	221.4	236.3	260.6	r 289.3

r Revised.

Source: Ekonomika neftyanoy promyshlennosti (Economics of the Petroleum Industry), Moscow. No. 7, July 1976, p. 47.

It was planned to extract 342 billion cubic meters of natural gas in 1977, an increase of 21 billion cubic meters over 1976 output. Most of the increase is expected to come from fields in western Siberia.

Extraction of natural gas in 1980 is planned at 435 billion cubic meters, about 146 billion cubic meters over that of 1975. Most of the increase is to come from the following gasfields: Urengoy, Medvezh'ye, Vyngapurovsk, Komsomol'sk (western Siberia), and Orenburg.

The Ministry of Construction of the Enterprises of the Oil and Gas Industry did not fulfill plans for the development of oil and gas fields and construction of gas pipelines, compressor stations, and underground gas storage, according to official reports.

During the 1971–75 period, capital investment in the Soviet gas industry totaled 10,180.2 million rubles, distributed as follows, in million rubles: 1971—1,383.1; 1972—1,674.7; 1973—2,036.1; 1974—2,501.0; and 1975—2,585.3.[24]

Gasfields.—The Ukraine maintained first place in the production of gas in 1976, accounting for 21.4% of the national output. Thirty-four gasfields were in operation in 1976, including Shebelinka and Efremovka.

Production of gas in the Bukhara-Khivinskiy region (eastern Turkmenistan and western Uzbekistan) reached 98.6 billion cubic meters in 1976, an increase of 11% over that of 1975. In 1976, 21 gasfields were in operation (including 6 in eastern Turkmenistan), and 15 gasfields were under development. The gasfield at Gazli, the largest in Uzbekistan, produced over three-fourths of the Republic's total gas output from 351 developmental wells.

Western Siberian gas production increased from 9 billion cubic meters in 1970 to nearly 36 billion cubic meters in 1975 and 47.8 billion cubic meters in 1976. The region is to produce 115 billion to 145 billion cubic meters in 1980, 26% to 33% of

[24] Ekonomika gazovoy promyshlennosti (Economics of the Gas Industry), Moscow. No. 4, April 1977, pp. 3–13.

the Soviet total. Almost two-thirds of total Soviet natural gas reserves are located in western Siberia. Four fields were in operation in this region—Punga, Igrim, Pakhomovsk, and Medvezh'ye. The latter is the largest of the four. Development of the Urengoy gasfield in this region, the U.S.S.R.'s largest gasfield, began in 1975. It is expected that gas production here will begin in 1978.

As most of the older producing regions are past their peak, current development is shifting attention to gasfields in western Siberia. About 85% of the planned increase in production during the 1976–80 period is expected to come from this region.

The Orenburg gas condensate field was one of the largest projects of the ninth 5-year plan. Two stages of the Orenburg complex, with a combined annual capacity of 30 billion cubic meters of natural gas, 800,000 tons of sulfur, and 2.4 million tons of gas condensate, were put into operation in 1974 and 1975. The third and last stage, also with a capacity of 15 billion cubic meters of gas, is scheduled for completion in 1978. This stage will consist of 100 operational wells and processing plants. Under a contract signed in September 1975, the French firm Creusot-Loire is to supply the U.S.S.R. with extraction and field processing equipment for the third stage. Reportedly, the French firm TECHNIP and the Soviet firm Tekhmashimport have signed an Fl-billion contract for a natural gas desulfurizing plant for the third stage. The plant is to have a processing capacity of 15 billion cubic meters of gas per year, the same as that of the first two, which were also constructed by TECHNIP.

Production of gas at the Vuktyl gas condensate field in Komi A.S.S.R. increased from 18.5 billion cubic meters in 1975 to 19.6 billion cubic meters in 1976.

Transportation.—The great distance between the principal consuming centers and the gasfields requires large pipelines for the bulk of natural gas. About 95% of the 1976 natural gas production was carried by trunk pipelines, and only 5% was consumed at or near the place of production. The total length of gas trunk pipelines increased from 99,200 kilometers in 1975 to 104,700 kilometers in 1976. Completion of an additional 6,500 kilometers of gas trunk pipelines, and 42 compressor stations is planned for 1977.

The total length of major gaslines and branches at yearend, in thousand kilometers, was reported or expected to be as follows: 1970—67.5; 1975—101.2; 1977—114.0; and 1980—137.0.[25]

Capital investment in gas transportation accounts for more than 60% of total investment in the gas industry. During the 1971–75 period, it totaled 6,260.5 million rubles, as follows, in million rubles: 1971—769.4; 1972—1,088.7; 1973—1,276.4; 1974—1,540.0; and 1975—1,586.0.[26]

Transportation costs of gas, in rubles per ten thousand cubic meters, were as follows: 1971—12.11; 1972—12.24; 1973—11.90; 1974—12.21; and 1975—13.44.[27]

A Government decree published in December 1976 provided for the construction in 1976–80 of a new facility at the Vyksun plant in the Urals to produce welded multilayered pipe with a diameter of 1,220 to 1,420 millimeters. The annual capacity of the new plant is to be 1 million tons per year.

The 1977 plan calls for construction of about 2,000 kilometers of gas pipelines and 20 compressor stations in the Tyumen Oblast-Ukhta-Western Border system in the northern regions. Among the gas pipeline construction projects to be in progress in 1977 were Nadym-Punga (fourth stage), Punga-Vuktyl-Ukhta (first stage), Ukhta-Torzhok (third stage), Torzhok-Minsk-Ivatsevichi (second stage), and Ivatsevichi-Dolina-Uzhgorod-Western Border (first stage). More than 1,000 kilometers of gas pipeline is to be laid in the Nizhnevartovsk-Kuybyshev system. Sections of considerable length are to be constructed on the Nizhnyaya-Tura-Perm (third stage) and Perm-Kazan-Gor'kiy (second stage) routes.

In 1976–80, 36,500 kilometers of underground gaslines is to be built. Almost 30% of this consists of 1,420-millimeter-diameter pipe. Compressor stations are to be outfitted with gas-pumping aggregates with a capacity of up to 25,000 kilowatts.

Exports.—Although the U.S.S.R. became a net exporter of natural gas only in 1974, the role of Soviet gas in the international market has grown in recent years. Exports of natural gas from the Ukraine totaled

[25] Ekonomicheskaya gazeta (Economic Gazette), Moscow. No. 6, February 1977, p. 2.
[26] Ekonomika gazovoy promyshlennosti (Economics of the Gas Industry), Moscow. No. 5, May 1977, pp. 3–10.
[27] Work cited in footnote 26.

25.8 billion cubic meters in 1976, a 6.5-billion-cubic-meter increase over those of 1975. The share of Soviet gas production exported reached 8%, compared with the previous year's 6.7%. Prices for exported gas rose along with volume and earnings as foreign natural gas sales increased from 451.3 million rubles in 1975 to 733.4 million rubles in 1976. Gas should soon rank next to oil as an important Soviet hard-currency export commodity.

Soviet exports of natural gas in 1973–76 are given, in billion cubic meters, in the following tabulation:

Destination	1973	1974	1975	1976
Czechoslovakia	2.4	3.2	3.7	4.3
Germany, West	.4	2.1	3.1	4.0
Italy	--	.8	2.3	3.7
Germany, East	.7	2.9	3.3	3.4
Austria	1.6	2.1	1.9	2.8
Poland	1.7	2.1	2.5	2.5
Bulgaria	--	.3	1.2	2.2
Hungary	--	--	.6	1.0
France	--	--	--	1.0
Finland	--	.5	.7	.9
Total [1]	6.8	14.0	19.0	25.8

[1] Data may not add to totals shown because of independent rounding.

Czechoslovakia remained the biggest buyer of Soviet natural gas in 1976, while East Germany, the second largest importer in 1975, fell to fourth place behind West Germany and Italy. France bought Soviet pipeline natural gas for the first time in 1976.

Austria was the first Western European country to import Soviet natural gas under a 23-year agreement signed in 1968 and a letter agreement signed in 1974. The U.S.S.R. has three agreements (1970, 1972, and 1974) with West Germany's Ruhrgas AG for delivery of gas over 20 years in exchange for large-diameter steel pipe and pipeline construction equipment. West Germany began to receive Soviet gas in 1973.

In 1974, Italy joined the group of Western European importers of Soviet natural gas. Beginning in 1977, 6 billion cubic meters of Soviet gas will be sent annually to Italy under a 20-year agreement. Deliveries of Soviet gas to Finland under a 20-year agreement started in 1974 and will be raised to 1.4 billion cubic meters per year. Also starting in 1977, 2.5 billion cubic meters of Soviet gas will be sent annually to France under a 20-year agreement.

The U.S.S.R. intends to further increase deliveries of natural gas to Western European countries by means of a second international pipeline of 28-billion-cubic-meter annual capacity, to be constructed by 1978. This will also increase deliveries of gas to Czechoslovakia and begin supply of gas to Yugoslavia.

The total length of both stages of the international gasline, including branches, is to be 10,000 kilometers. The main distribution center is Czechoslovakia, whence gas flows through several branch lines to East Germany, West Germany, Austria, and Italy. An additional branch line to France is planned. It is expected that annual Soviet exports of natural gas to Italy, in exchange for additional equipment and plants, will rise from the anticipated 7 billion cubic meters to 10 billion cubic meters.

The North Star Siberian gas project for the extraction, liquefaction, and export of natural gas to the United States and Western Europe from the Urengoy gasfield was abandoned in 1974, following unfavorable reception of the plan in the U.S. Congress.

Under a new proposal, British, French, and West German banks and financial institutions are to make loans to the U.S.S.R. to buy a French liquefied natural gas plant, West German pipe, and British auxiliary equipment for the project. The U.S.S.R. was studying this proposal in 1976.

Soviet deliveries to CMEA countries in 1976 increased about 19% over those of 1975 and are to be doubled by 1980. The U.S.S.R. plans to substitute natural gas for oil wherever possible in exports to Eastern Europe.

Under the Soviet-Hungarian agreement of 1971, delivery of natural gas through the first stage of the Soviet-Hungarian Brotherhood Gas Pipeline began on May 1, 1975, and through the second stage in February 1976. Hungary received 0.6 billion cubic meters of Soviet gas in 1975 and 1 billion cubic meters in 1976; deliveries are to be increased substantially by 1980 to provide gas for both Hungary and Yugoslavia. The annual capacity of the pipeline was 2 billion cubic meters in 1976 and is to be 2.6 billion cubic meters in 1979.

Deliveries of Soviet natural gas through the joint CMEA pipeline from the Orenburg field have been planned for the early 1980's at 15.5 billion cubic meters annually, with 2.8 billion cubic meters each to Czech-

oslovakia, Poland, East Germany, Hungary, and Bulgaria and 1.5 billion cubic meters to Romania. The 1,420-millimeter-diameter pipeline will be 2,677 kilometers long. The capacity of this line is to be 28 billion cubic meters per year. Over 13,000 Eastern European workers were working in the U.S.S.R. in 1976 on construction of this line, which is to be completed in spring of 1979.

According to a Soviet-Bulgarian agreement, the U.S.S.R. is to supply Bulgaria with 3 billion cubic meters of natural gas annually by 1980. Bulgaria is also to receive 2.8 billion cubic meters per year from the Orenburg pipeline. A contract for the supply of 4.5 billion cubic meters of natural gas to Czechoslovakia in 1977 was signed in Prague on December 9, 1976.

Soviet gas reserves are about 25 trillion cubic meters, but the development of all these reserves would be extremely difficult and costly. One problem of development at the western Siberian gasfields is that it takes about 1.5 years to get a piece of heavy equipment in place. Despite the enormous gas reserves, the U.S.S.R. is not likely to become a major world gas exporter. Siberian gas will, however, become a major factor in the domestic energy balance.

Soviet exports will be offset to some extent by imports of gas from Iran and Afghanistan, which decreased from 12.5 billion cubic meters in 1975 to 11.8 billion cubic meters in 1976.

The route of the pipeline from the Soviet-Iranian frontier, which will pump Iranian gas to West Germany through the U.S.S.R.'s gas transport system, was designed in 1976. The transcontinental pipeline, some 4,000 kilometers long, will carry over 12 billion cubic meters per year. On the basis of long-term loans, West German firms supply the U.S.S.R. with pipe and equipment to speed up development of gasfields. Repayment is to be made in future deliveries of gas to West Germany.

Soviet natural gas statistics are presented in table 7.

Table 7.—U.S.S.R.: Salient natural gas statistics [1]

(Billion cubic meters)

	Actual				Forecast
	1970	1974	1975	1976	1980
Production	197.9	260.6	r 289.3	321.0	435.0
Exports:					
To Western Europe:					
Austria	1.0	2.1	1.9	2.8	r 3.0
Finland	--	.5	.7	.9	1.4
France	--	--	--	1.0	4.0
Germany, West	--	2.1	3.1	4.0	8.5
Italy	--	.8	2.3	3.7	6.0
Total	1.0	5.5	8.0	12.4	r 22.9
To Eastern Europe:					
Bulgaria	--	.3	1.2	2.2	r 5.8
Czechoslovakia	1.3	3.2	3.7	4.3	6.0
Germany, East	--	2.9	3.3	3.4	5.0
Hungary	--	--	.6	1.0	3.8
Poland	1.0	2.1	2.5	2.5	4.5
Romania	--	--	--	--	1.5
Yugoslavia	--	--	--	--	1.0
Total	2.3	8.5	11.3	13.4	r 27.6
Total exports	3.3	14.0	19.3	25.8	r 50.5
Imports:					
From Iran	1.1	r 9.1	9.6	8.9	11.0
From Afghanistan	2.5	r 2.8	2.9	2.9	r 3.5
Total	3.6	11.9	12.5	11.8	r 14.5
Net exports	—.3	2.1	6.8	14.0	r 36.0
Apparent consumption	198.2	258.5	r 282.5	307.0	r 399.0

r Revised.

[1] Production data are from: National Economy of the U.S.S.R., Moscow. 1970, 1974, and 1975; and Pravda, Moscow. Jan. 23, 1977. Trade data are from: Vneshnyaya torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. 1970, 1974–76.

Oil Shale.—Soviet minable oil shale reserves in place in the measured, indicated, and inferred categories are 6.4 billion tons, and in the potential category 6 billion tons. About 75% of the reserves are concentrated in the Baltic Basin (the Estonian and Leningrad Oblast deposits), with some in the Volga region (the Kashpari desposit). The largest oil shale reserves are in Estonia. Production of oil shale increased from 32.5 million tons in 1975 to 33.0 million tons in 1976; it may reach 36 million tons in 1977 and 38 million tons in 1980. Over two-thirds of the extracted shale in the U.S.S.R. is burned at the Pribaltiyskaya and Estonskaya thermoelectric powerplants. The remainder is processed into furnace oil, gasoline, fuel gas, phenols, and aromatic hydrocarbons. Oil shale is also used in everyday commercial needs. The world's largest powerplant fueled by oil shale in Tallinn has reached a capacity of 1.6 million kilowatts.

There were 13 underground mines with a total capacity of 22.3 million tons and 4 open pits with a capacity of 12.1 million tons in operation in 1976. The main center of production, as in prior years, was Estonia, where output totaled about 29 million tons in 1976 and is expected to exceed 30 million tons in 1980. In 1976, there were eight underground mines and four open pits in operation in Estonia. Production of oil shale in this Republic has increased more than 50% over that of 1970. The first and largest walking excavator in the country, with a bucket of 35 cubic meters, was put into operation at the Oktyabr' open pit in Estonia in April.

Most of Estonia's oil shale occurs in thin seams at depths of 20 to 30 meters. An increasing proportion is obtained from open pits. The future development of the Republic's oil shale industry is impeded by limited reserves of untapped shale deposits, shortage of manpower, limited capacity of existing petrochemical enterprises, and environmental protection. According to Soviet sources, dust and pollution of air, rivers, and ground water exceed permissible standards at many places in the Estonian oil shale basin. It has been decided to begin development of the middle-Dnepr oil shale deposit, which has been estimated to contain over 3 billion tons of oil shale.

In 1976, three underground oil shale mines in Leningrad Oblast produced some 5 million tons; over 1 million tons came from two underground mines in the Volga region.

Reportedly, Thailand has accepted an offer from the U.S.S.R. of technical assistance for oil shale development.

Peat.—The U.S.S.R. produced an estimated 191.6 million tons of peat in 1976. Of this quantity, 60 million tons consists of fuel peat and 131.6 million tons is agricultural peat. Production of 99 million tons of agricultural and 40 million tons of fuel peat came from collective farms. The R.S.F.S.R. occupied first place in peat production in the U.S.S.R. in 1976 and produced some 120 million tons, including an estimated 40 million tons of fuel peat. Belorussia, with an estimated output of 44 million tons, was the second largest peat-producing region.

Soviet gross reserves of peat increased between 1955 and 1975 from about 20 billion tons to 39 billion tons SCE. However, about 11% of the current minable reserves are located in the central European part of the U.S.S.R.—Belorussia, the Baltic States, and the Ukraine region—which produced over 80% of the national output in 1976. Analysis of past trends and Soviet potential facilities indicate that extraction of peat may reach 220 million tons (including 80 million tons of fuel peat) in 1980.

There were 79 electric powerplants fueled by peat in operation in the U.S.S.R. in 1976, with a total capacity of about 4,000 megawatts. A number of new powerplants with a capacity of 600 megawatts each were being constructed in different regions of the U.S.S.R. in 1976. Fuel peat is also used in domestic heating.

Petroleum.—In 1976, the U.S.S.R. produced 519.7 million tons of crude oil and gas condensate, a 5.8% increase over 1975 output. For the third year, the U.S.S.R. remained the world's largest oil producer. The country continued to expand exports of crude oil and petroleum products even though supplies available for internal consumption were tight. Nearly 29% of the total (148.5 million tons) was exported either as crude oil (110.8 million tons) or as refinery products (37.7 million tons). Exports of crude oil and products in terms of value accounted for as much as 27.4%

of total official Soviet exports in 1976. Soviet imports of crude oil and petroleum products increased from 4.6 million tons in 1970 to 14.7 million tons in 1973 and dropped thereafter to 5.4 million tons in 1974, 7.6 million tons in 1975, and 7.2 million tons in 1976. The share of petroleum in the U.S.S.R.'s total primary energy production reached an estimated 44.5% in 1976, and its share of consumption was 37.8%.

In 1976, over 500 (including 36 large) oil and gas condensate fields were in operation, with a total of over 67,000 wells. Increased production came from 9 of the 26 producing regions, mainly western Siberia, Udmurt A.S.S.R., Komi A.S.S.R., Perm Oblast, and Georgia. In western Siberia, which has over 140 oilfields, 21 fields were producing in 1976, the largest of which was Samotlor.

The 1976 oil production quota was filled by putting 4,798 (instead of the 4,453 planned) new wells into operation, putting in new pumping equipment at 874 wells, switching 3,215 wells to mechanized methods of operation, and putting 1,184 inactive wells into production. To maintain the formation pressure, 1,100 million cubic meters of water was pumped into producing levels, 115 million cubic meters more than in 1975. In 1976, the U.S.S.R. drilled about 12.1 million meters of developmental and exploratory wells, 0.4 million meters more than in 1975.

The U.S.S.R. plans to increase oil recovery from oilfields under current exploitation. To the Soviets, it is more rational to increase secondary and tertiary recovery of petroleum than to develop new oilfields. The use of chemical agents and the injection of warm water and steam have been tested successfully and are being introduced.

The U.S.S.R. invests considerable sums of money and material resources in oil industry development. The fixed capital invested in the industry was more than 20 billion rubles by January 1, 1976. In 1976 alone, 4.4 billion rubles was invested in the oil industry.

Underground mining of oil sands has been practiced in Komi A.S.S.R. (the Yarege mine) since 1972. Operations there consisted of shaft sinking, drifting, drilling of production boreholes, and injection of steam, followed by underground separation of crude oil and waste and pumping recovered oil to the surface.

Development of an underground oil-producing mine in Azerbaydzhan began in 1976, with completion scheduled for 1980. The mine is to be developed by two vertical shafts to a depth of 400 meters.

Reportedly, the U.S.S.R. and Algeria have agreed to expand cooperation in the oil and gas industries. Some 15 Soviet drilling rigs have been sent to Algeria, and representatives of the two countries have studied the possibility of Soviet participation in construction of a number of oil refineries in Algeria.

Exploration and Reserves.—The U.S.S.R. is rich in oil. However, despite new discoveries, the rate of incremental growth in oil reserves is lagging behind the growth rate of crude oil extraction.

Crude oil reserves (indicated plus inferred) in place increased by about 400 million tons in 1975. As of January 1, 1976, the gross reserves of crude oil in place in the U.S.S.R. may total 23 billion tons, including 1.5 billion tons measured (Soviet category A), 3.3 billion tons indicated (category B), 5.2 billion tons inferred (category C_1), and 13 billion tons potential (category C_2). The ratio of A plus B reserves in place to production was 10:1 in 1975. A 30% to 40% recovery of crude oil in place was claimed in 1975. The reserve-to-production ratio for the country as a whole has declined 45% from that of 1955 and 20% from that of 1970.

Future Soviet plans covering the development of the oil industry's prospecting and drilling operations were based on a reserves-in-place-to-production ratio. This ratio, which governed exploration activities, included reserve categories A, B, and C_1 and was set at 20:1 to 25:1 for planning purposes. In actual fact, however, the ratio was 20:1 during 1975.

Planning has departed from earlier practices to assume greater risk in petroleum development decisionmaking. The reserves to be developed in category C_1 have been extended to include 80% to 85%, while those in category B have been reduced by a factor of 2.0 to 2.5. The share of reserves in the lowest category classed among commercial reserves, C_1, increased from 32.6% in January 1959 to 52.1% in January 1974.

During 1959–72, more detailed exploration confirmed only 61.5% of the reserves of category C_1, shifting them to categories A and B. The degree of confirmation of

reserves of category C_2 over most of the country is too low to meet standards of prospective planning and development. Only 40% of the crude oil reserves classified as category C_2, the lowest category, were transferred to category C_1 during 1959–72.

In support of the planned increase in crude oil output, more than 12 million meters of exploratory and developmental wells was drilled in 1976, an increase of 3.5% over that of 1975. The plan for drilling of developmental wells was overfulfilled 2.7%, but fell 5.8% short for exploratory drilling. Some 4,946 developmental wells and more than 900 exploratory wells were drilled in 1976. Despite these figures, 30% of the drilling enterprises did not meet planned targets in drilling. Especially poor performance was shown by units operating near the Caspian Sea and in Azerbaydzhan, Turkmenistan, Orenburg, Saratov, Belorussia, western Siberia, Mangyshlak Peninsula, and other associations. In 1976, geologists in Tyumen Oblast (western Siberia) failed to fulfill the plan for increasing proved reserves of oil. Transportation remained a basic problem, and there was a shortage of many kinds of equipment and materials.

The average depth of wells increased from 1,665 meters in 1970 to over 1,850 meters in 1976, and the drilling cost per well increased from 123,000 rubles to about 170,000 rubles for the same period.

The Soviet-Japanese agreement for joint exploration of offshore oilfields adjacent to Sakhalin Island added to exploration work and is to aid the U.S.S.R. in putting a significant exploration effort into offshore areas in the northern Barents and Kara Seas and the Sea of Okhotsk in the Soviet Far East.

Production.—In 1976, oil was produced in 26 regions, the most significant of which are located in the Volga-Urals area. Western Siberia was next, followed by the regions in the North Caucasus and Kazakhstan. Most of the U.S.S.R.'s increased production was, however, derived from the western Siberian fields, where about 182 million tons was produced in 1976. The Volga-Urals area is to maintain its leading position until the developing oilfields of western Siberia, Mangyshlak Peninsula, and Turkmenistan come onstream. Nineteen of the country's twenty-six oil-producing regions fulfilled the 1976 production goal. The Mangyshlak Peninsula, Turkmenistan, Ukraine, Caspian Sea, Belorussia, Lower Volga, and Azerbaydzhan oil-producing associations did not meet the 1976 production targets.

Among the oil-producing regions, western Siberia held the leading place, followed by Tatarstan, Bashkiria, Kuybyshev Oblast, Perm Oblast, and Mangyshlak Peninsula in Kazakhstan. In 1976, the increase in oil extraction amounted to 28.7 million tons. Oil extraction in western Siberia increased by 33.9 million tons and in Komi A.S.S.R. by 1.6 million tons.

There were over 140 oilfields in western Siberia on January 1, 1977, but only 21 fields were in operation in 1976. These included the Severo-Vareganskoye Lokosovskoye, Severo-Pokurskoye, Yuzhno-Surgatskoye, Yuzhno-Balykskoye, and Vakhskoye fields which were put into operation in 1976. Some 1,286 developmental wells were completed in western Siberia in 1976; this was 26.6% more than in 1975. Some 319.2 million cubic meters of water was injected in 1976, 60.8 million cubic meters more than in 1975. Especially intensive development took place at the Samotlor field, where 546, or 42.5%, of the total new western Siberian developmental wells were put into production. Oil extraction in western Siberia increased from 148 million tons in 1975 to about 182 million tons in 1976, an increase of 23%. The Samotlor oilfield in Tyumen Oblast, the largest oilfield in the U.S.S.R., accounted for 55% of the oil extracted in western Siberia. About 2,000 wells were producing at this field in 1976. The Fëdorov field was the second largest in western Siberia in 1976.

In the Volga-Urals area, the so-called Second Baku, output was concentrated in Tatarstan, Bashkiria, and Kuybyshev Oblast. For 7 years, Tatarstan, where the basic oilfields have entered the late stage of their development, has maintained an annual extraction level of 100 million tons. In 1976, 1,075 developmental wells were put into operation. The Romashkino oilfield is the largest in this Republic. Exploitation of the Kalauzhskoye oilfield began in May. Bashkiria produced about 40 million tons of crude oil in 1976.

Komi A.S.S.R.'s crude output increased from 7.1 million tons in 1975 to 8.7 million tons in 1976, an increase of 23%. Some 70

developmental wells were drilled in this Republic in 1976. In Azerbaydzhan, extraction of crude oil has been declining at onshore and offshore fields for the past several years.

Offshore oil extraction began in 1949 in the area of Neftyanyye Kamni (Oil Stones) in Azerbaydzhan. The fields are 20 to 25 kilometers from the coast and accounted for about two-thirds of the total output of Azerbaydzhan in 1976. Although the cost of developing offshore fields was considerably higher than that for onshore fields, the production cost was 30% to 35% below that of onshore fields because of the greater average yield. About 2,000 developmental wells have been drilled from steel trestles, which extend more than 200 kilometers from shore. Until 1976, drilling platforms were installed at a water depth of 10 to 30 meters, but construction of platforms at greater depths has since been undertaken.

Oil was also produced from several offshore wells in Turkmenistan, where several oilfields have been found. Development of the Zhdanov and Lam fields in Turkmenistan continued in 1976. It is expected that the offshore oilfields of Azerbaydzhan and Turkmenistan will merge in the Caspian Sea in the future.

During 1971–76, about 900,000 meters was drilled offshore Azerbaydzhan. The average depth of wells was steadily increasing, and by the end of 1976, it was to exceed 5,000 meters. According to Soviet calculations, 60% to 65% of the predicted reserves of oil and gas in Azerbaydzhan are to be found offshore. To make full use of these reserves, however, the U.S.S.R. would have to use new techniques and practices.

A floating drilling rig, the *Kaspiy,* designed in Baku and built at the Krasnye Barrikady shipyard in Astrakhan, became operational in the Caspian Sea in October 1974. It is capable of drilling a 6,000-meter well in water depths up to 60 meters. The *Kaspiy* is the first of 10 such rigs to be constructed during 1970–80. The second rig of this series, the *Baku,* with similar capabilities, was activated in summer of 1975. The third rig, the *60 Years of October,* was under construction in 1976 and was scheduled for completion in 1977. According to Soviet sources, this rig, being built in Astrakhan, will drill wells up to 6,000 meters deep in water up to 75 meters deep.

The Ministry of the Oil Industry set up a new organization, the Administration for Exploratory Drilling from Floating Rigs, which has special responsibilities for operating the floating rigs. This administration will manage the *60 Years of October* and future floating rigs as they are completed.

Soviet offshore oil production has thus far been concentrated in the shallow waters of the Caspian Sea. Deep offshore drilling was limited by the available equipment. The U.S.S.R.'s lack of floating rigs caused the Soviets to accelerate fabrication of fixed platforms in water 15 to 20 meters deep. The largest platform was designed for use in 80 meters of water.

Reportedly, Armco Steel Corp. of the United States and Rauma-Repola Oy of Finland have signed an agreement to build a $40 million semisubmersible oil-drilling vessel for the U.S.S.R. The ship will be used for offshore oil drilling in the Caspian Sea. The U.S.S.R. is shopping in the West for several plants to manufacture fixed platforms for offshore oil production, movable drilling rigs, and subsea production equipment.

Refining.—Direct information pertinent to refining and utilization of petroleum products is classified as a State secret and is not available. Indirect information indicates, however, that for many years, Soviet practices in dewatering, desalting, and crude stabilization have lagged behind the technical level of other countries.

The Soviet oil supply chain follows the oilfield-pipeline-refinery pattern. Water and other impurities in the crude, amounting to several million tons, cause difficulties and affect the performance of refineries. Water content in the crude received by Soviet refineries reached 1% to 2%, with 300 to 3,600 milligrams of chloride salts per liter, compared with a norm of 0.2% water and 40 milligrams of salt per liter.

As a result of inadequate pretreatment of crude in the oilfields, according to Soviet sources, refinery consumption and losses amount to 13.4%. The total losses incurred by refining insufficiently desalinated crude oil have been reported at more than 200 million rubles per year. Losses in storage and transportation to refineries of crude oil are estimated at 1.6%. Because of the high water and salt content, corro-

sion and wear of refinery equipment is greater.

Assuming a yield of 85% of the reported crude petroleum input because of the documented losses and quality factors mentioned, Soviet output of refined products in 1976 has been estimated at 352 million tons, 8 million tons over that of 1975. Available production and trade data indicate Soviet consumption of refined products in 1976 to be an estimated 315 million tons. Production of lower quality petroleum products, including low-octane gasoline and high-sulfur diesel fuel, continued in 1976.

The 1976–80 5-year plan envisaged a petroleum product output increase of 25% to 30% over that of 1975. In 1976, however, the planned goal was not achieved. Estimated refinery capacity at yearend totaled 395 million tons per year, an increase of 15 million tons over the 1975 level. Over 80 refineries were in operation in 1976.

With the participation of Western firms, the first stage of the Lisichansk oil refinery in the Donets Basin and new facilities at the Kremenchug (Ukraine) and Novo-Baku (Azerbaydzhan) refineries were put into operation in 1976. The following new oil refineries were under construction: Achinsk, Chardzhou, Chimkent, Lisichansk, Mažeikiai, Mozyr, Pavlodar, Tobolsk, Tomsk, Vinnitsa, and Zaporozhye. Modernization of the Novobaku Vladimir Il'ich oil refinery continued in 1976.

Transportation.—Some 85% of the total tonnage of crude oil and refinery products transported in the U.S.S.R. in 1976 was moved by pipeline. The remainder was delivered by rail. Because of incomplete construction of pipelines, about 15 million tons of crude was carried by rail routes paralleling pipelines. Product transportation by pipeline continued to be small. Crude oil and products represented about 15% of Soviet railroad freight traffic in 1976. The average distance of railroad deliveries in 1976 was 1,242 kilometers.

The total length of crude oil and petroleum product trunk pipelines in 1976 was 58,500 kilometers. Only about 70% of total pipeline capacity was utilized. The network of crude oil and petroleum product lines increased by an estimated 1,600 kilometers in 1976 and included the second stage of the Okha-Komsomol'sk pipeline, the Bulla-Baku underwater pipeline, and other crude oil pipelines. Construction began on two 1,200-millimeter-diameter pipelines in 1976: Surgut-Perm-Gor'kiy-Polotsk (3,900 kilometers long) and Omsk-Pavlodar-Chimkent (1,620 kilometers long). The Polotsk-Birzhai-Mazheykyay pipeline (442 kilometers long) was being constructed by Polish workers.

The Friendship pipeline, with a total length of 4,648 kilometers, crosses five countries. Through this pipeline the U.S.S.R. supplies crude oil to refineries at Plock in Poland and Schwedt in East Germany in the north and Százhalombatta in Hungary and Bratislava-Trnava in Czechoslovakia in the south. The Friendship pipeline branch to Klaipėda in Lithuania supplies oil for export to the Scandinavian countries. The Friendship No. 2 crude pipeline was under construction, scheduled for completion in 1977.

The growth of the estimated total length of crude oil and petroleum product trunk pipelines is shown, in thousand kilometers, in the following tabulation:

Year	Crude oil pipelines	Product pipelines	Total
1940	4.0	0.1	4.1
1945	4.0	.4	4.4
1950	4.5	.9	5.4
1955	8.4	2.0	10.4
1960	14.3	3.0	17.3
1965	23.2	5.0	28.2
1970	31.6	5.8	37.4
1975	48.6	8.3	56.9
1976	50.0	8.5	58.5

Pipeline construction in the U.S.S.R. lagged behind schedule, mainly because of a shortage of pipe. Thus far, only 75% of Soviet pipe requirements came from indigenous suppliers; during 1971–75, about one-half of the requirements for large-diameter pipe came from West Germany, Austria, Italy, Sweden, and Japan. Soviet steel pipe imports, mostly large-diameter sizes used for oil and gas lines, reached about 3 million tons in 1976, compared with 2.7 million tons in 1975. The largest foreign suppliers of pipe in 1976 were West Germany, Italy, Japan, Romania, and France. Much of the pipe imported from Western European countries will be paid for by long-term deliveries of Soviet natural gas.

A Soviet-Nigerian contract provides for the construction of two pipelines in Nigeria. The value of the contract is estimated at

$137.5 million. Delivery of the equipment is to be completed in the first half of 1977.

The supply of tankers is a key factor in the export of Soviet oil from Baltic and Black Sea ports to Western Europe. The U.S.S.R. attaches great importance to having its own tanker fleet. As of June 30, 1970, the tanker fleet (vessels in the 6,000-deadweight-ton and over class) consisted of 187 vessels totaling 4.3 million deadweight tons. In 1970, some 74 million tons of oil was carried by tankers, including 42 million tons in non-Soviet shipping. The 1971–75 plan called for increases of 50% in tanker tonnage and 65% in the tanker fleet cargo turnover. By 1980, Soviet tanker fleet tonnage may reach 9 million tons. These published data confirm Soviet intentions to increase oil exports to Western Europe in 1980 over those of 1975. The first large Soviet-built tankers, the 182,000-ton *Krym* and *Kuban,* successfully completed trial runs in the Black Sea in 1974–76. These tankers are 2.5 times larger than the *Sofiya*-type Soviet tankers. Two large tankers, *Kavkaz* and *Kuzbass,* were under construction in 1976.

Exports.—The U.S.S.R. became a net exporter of crude oil in 1951 and of petroleum products in 1954, and has gradually strengthened its position since that time. Crude oil exports increased from 0.9 million tons in 1951 to 93.1 million tons in 1975, and exports of petroleum products rose from 4.4 million tons in 1954 to 37.3 million tons in 1975. In 1976, exports of crude oil and petroleum products totaled 148.5 million tons (13.9% over those of 1975) and consisted of 110.8 million tons of crude oil (75%) and 37.7 million tons of petroleum products (25%). The U.S.S.R. exported more than 17% of its production in 1976.

Because of inadequate Soviet refining facilities, overall exports of crude oil are known to have risen far more rapidly than overall exports of products.

Crude oil and petroleum product exports from the U.S.S.R. to market economy countries rose from 52.6 million tons in 1975 to 64.5 million tons in 1976, an increase of about 23%. As usual, most of these exports were absorbed by Western European markets in 1976, where they serve to pay for imports of industrial goods. Italy imported 12 million tons of crude oil and petroleum products, emerging as the largest purchaser of Soviet oil in the West, followed by Finland and West Germany. Soviet oil exports to the United States and the United Kingdom more than doubled in 1976, but there was an actual decline in sales to the Netherlands and Sweden.

Crude oil and petroleum product exports to centrally planned economy countries increased 8% from 77.8 million tons in 1975 to 84 million tons in 1976 (including 77.6 million tons to CMEA nations). Czechoslovakia remained the largest importer of Soviet oil, followed by East Germany, Poland, Bulgaria, Cuba, Hungary, and Yugoslavia.

Exports of crude oil and petroleum products from the U.S.S.R. in 1973–76 are shown in table 8. The weighted average value of Soviet exports of crude oil and petroleum products for the period 1973–76 is given in table 9.

Table 8.—U.S.S.R.: Exports of crude oil and petroleum products, 1973–76 [1]

(Million metric tons)

Destination	1973	1974	1975	1976
Centrally planned economy countries:				
Czechoslovakia	14.3	14.8	16.0	17.2
Germany, East	13.0	14.4	15.0	16.8
Poland	12.3	11.9	13.3	14.1
Bulgaria	9.3	10.9	11.6	11.9
Cuba	7.4	7.6	8.1	8.8
Hungary	6.3	6.7	7.5	8.4
Yugoslavia	3.9	3.8	4.4	4.9
Korea, North	.6	.9	1.1	1.1
Mongolia	.3	.3	.4	.4
Vietnam	.2	.3	.4	.4
Total	67.1	71.6	77.8	84.0
Market economy countries:				
Italy	8.7	6.8	6.9	12.0
Finland	10.0	9.2	8.8	9.6
Germany, West	6.4	6.8	8.4	8.2
France	5.3	1.4	3.3	5.7
United Kingdom	.8	.9	1.5	4.1
Netherlands	3.2	3.0	3.1	2.7
Sweden	3.2	3.0	3.5	2.7
Belgium	1.7	1.8	1.3	2.1
Spain	.5	1.4	1.7	2.0
Greece	.8	1.0	1.9	1.9
Japan	3.0	1.2	1.3	1.8
Denmark	.6	.7	1.2	1.6
Austria	1.3	.9	1.3	1.5
Brazil	1.6	1.2	1.5	1.1
India	.5	1.0	1.2	1.1
United States	--	.2	.5	1.1
Portugal	--	--	1.0	1.0
Switzerland	.7	.8	1.0	.9
Morocco	.9	.6	.6	.7
Iceland	.5	.5	.4	.4
Syria	--	--	--	.4
Canada	--	.1	.2	.3
Cyprus	.1	.1	.2	.3
Ghana	.6	.3	.1	.3
Egypt	.4	.2	.2	.2
Ireland	.2	.1	.2	.2
Norway	.6	.3	.3	.2
Afghanistan	.2	.2	.1	.1
Bangladesh	--	.2	.2	.1
Guinea	.1	.1	.1	.1
Somalia	.1	.1	.1	.1
Turkey	.4	--	--	--
Total	51.2	44.6	52.6	64.5
Grand total	118.3	116.2	130.4	148.5
Of which—				
Crude oil	85.3	80.6	93.1	110.8
Petroleum products	33.0	35.6	37.3	37.7

[1] Data may not add to totals shown because of independent rounding.

Source: Vneshnyaya torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. 1973–76.

Table 9.—U.S.S.R.: Weighted average value of exported crude oil and petroleum products, 1973–76 [1]

(Rubles per metric ton)

Destination	1973	1974	1975	1976
Centrally planned economy countries:				
Mongolia	37.4	36.0	36.1	64.2
Yugoslavia	25.5	40.8	59.1	55.6
Hungary	17.9	20.9	41.0	44.9
Poland	17.3	20.6	40.0	42.0
Korea, North	28.6	26.2	24.0	39.7
Bulgaria	14.6	15.2	34.2	37.4
Vietnam	43.3	38.6	35.3	36.1
Czechoslovakia	16.4	16.3	30.9	34.1
Cuba	15.4	17.8	30.8	32.8
Germany, East	14.2	18.8	28.2	32.0
Average	16.8	20.8	35.0	37.9
Market economy countries:				
Afghanistan	29.6	30.3	36.6	96.0
Guinea	28.9	82.8	75.4	91.0
Egypt	27.6	76.5	82.2	89.7
India	22.6	65.9	77.5	88.0
Bangladesh	--	68.9	77.5	85.3
Netherlands	42.1	67.9	65.0	82.5
Germany, West	36.6	66.8	62.3	80.8
Iceland	27.6	75.2	73.5	77.3
Syria	--	--	--	74.9
Switzerland	27.6	67.7	64.2	71.6
United Kingdom	20.7	76.1	64.7	68.8
Norway	19.0	75.0	63.5	68.7
Greece	22.0	67.1	59.5	67.0
Belgium	41.0	66.3	63.1	66.8
Denmark	51.3	61.3	57.6	66.6
Finland	22.1	67.0	61.9	66.3
Brazil	NA	64.3	60.2	65.6
Austria	22.8	67.6	58.7	65.5
United States	--	59.8	62.2	65.5
Italy	17.6	58.2	57.0	65.4
France	17.2	61.9	58.2	65.0
Somalia	25.9	38.1	72.6	64.9
Ghana	14.8	78.9	65.6	64.7
Portugal	--	--	59.0	64.5
Canada	--	50.8	53.0	64.3
Morocco	14.3	69.8	58.9	64.2
Japan	20.4	57.5	51.2	63.8
Spain	17.8	60.5	58.2	63.8
Sweden	18.1	55.5	50.1	61.2
Ireland	26.0	63.2	48.9	54.5
Cyprus	13.7	52.2	44.8	51.3
Turkey	15.0	--	--	--
Average	24.5	64.4	60.6	68.8
Overall average	20.3	37.4	45.7	51.7
Of which—				
Crude oil	15.8	28.9	40.4	46.3
Petroleum products	32.0	51.8	57.8	67.7

NA Not available.

[1] Average prices given are f.o.b. Soviet port or frontier.

Source: Vneshnyaya torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. 1973–1976.

Imports.—Imports of crude oil (all from market economy countries in Africa and the Middle East) and petroleum products (mainly from Western Europe) increased from 4.6 million tons in 1970 to 14.7 million tons in 1973 and then decreased to 7.6 million tons in 1975 and 7.2 million tons in 1976.

Iraq and the U.S.S.R. have contracted for the delivery to the U.S.S.R. of crude oil produced at the first national oilfield in Iraq at northern Rumaila. This oilfield was equipped with the financial and technical assistance of the U.S.S.R. In accordance with the contract, Iraq was to deliver 1 million tons of crude oil in 1972 and 2 million tons per year in the subsequent 3 years. In 1976, delivery of crude oil from Iraq amounted to 5.8 million tons.

Soviet imports of petroleum are presented in table 10.

Table 10.—U.S.S.R.: Imports of crude oil and petroleum products, 1973–76 [1]

(Million metric tons)

Source	1973	1974	1975	1976
Crude oil:				
Iraq	11.0	3.9	5.3	5.8
Syria	.2	.3	--	.5
Egypt	.2	.2	.2	.2
Algeria	--	--	1.0	--
Libya	1.7	--	--	--
Total	13.2	4.4	6.5	6.4
Petroleum products	1.5	1.0	1.1	.8
Grand total	14.7	5.4	7.6	7.2

[1] Data may not add to totals shown because of independent rounding.

Source: Vneshnyaya torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. 1973–76.

The weighted average value of crude oil and petroleum products imported into the U.S.S.R., in rubles per ton, was as follows: [28]

Source	1973	1974	1975	1976
Crude oil:				
Iraq	16.9	68.4	60.4	63.5
Syria	10.5	48.7	--	54.5
Egypt	6.7	51.3	49.5	52.9
Algeria	--	--	67.2	--
Libya	17.7	--	--	--
Average	16.7	66.3	61.1	62.6
Petroleum products	34.5	51.5	96.6	118.9

Source: Vneshnyaya torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. 1973–76.

State Plans.—Crude oil extraction (including gas condensate) is slated to rise to 550 million tons in 1977, an increase of 30.3 million tons or 5.8% over that of 1976. Expansion of output will depend largely on development of the Samotlor and other oilfields in western Siberia. Output of crude in this region is to rise by 32.5 million tons to 214.5 million tons in 1977.

It is planned to drill 12 million meters of wells, put 4,700 new developmental oil wells into operation, and lay 4,000 kilometers of oil pipelines. About 2,000 kilometers is to be laid on the Kuybyshev-Lisichansk, Lisichansk-Kremenchug, and Snegirëvka-Odessa crude oil pipelines. Capital investment is to rise 2.3% over that of 1976, reaching 4.5 billion rubles. Facilities with the following capacities are among those to be commissioned during 1977, according to trade journals: Crude oil collection, 100 million tons and crude oil preparation, about 70 million tons; 37 pumping stations are to be commissioned. To maintain the formation pressure, water injection is to rise 9% over that of 1976, reaching 1,190 million to 1,200 million cubic meters.

The 1977 plan calls for a 4.5% increase in primary refining of crude. Because of insufficient capacities for secondary refining of petroleum, problems arose with respect to the production of certain types of light petroleum products.

Planned Soviet production of crude oil in 1977, by region, is as follows, in million tons: [29]

[28] Average prices given are f.o.b. foreign port or frontier.

[29] Ekonomicheskaya gazeta (Economic Gazette), Moscow. No. 8, February 1977, p. 2.

Western Siberia	214.5
Tatarstan	98.9
Bashkiria	40.0
Kuybyshev Oblast	31.7
Perm Oblast	24.7
Mangyshlak Peninsula	19.5
Turkmenistan	13.9
Orenburg Oblast	12.9
Caspian Sea (offshore)	11.4
Komi A.S.S.R	10.9
Other	71.6
Total	550.0

The tenth 5-year plan envisages production of 620 million to 640 million tons of crude oil and gas condensate in 1980. The plan calls for the development of about 500 million tons of new capacity during the 1976–80 period; over two-thirds of this is to offset the decline in crude oil production at old fields, and about one-third (151 million tons) is to be available for a net growth in production. The average annual growth in crude oil extraction is to be increased to 30 million tons during the tenth 5-year plan.

A rapid increase in exploration and development of new oilfields and expedient application of the latest equipment and technology are the basic elements in the Soviet oil industry policy during the tenth 5-year plan. The central task of the oil-extracting industry during 1976–80 is to maintain the same level of output of crude oil in the Volga-Urals area and to bring about a great increase in oil extraction in western Siberia, Kazakhstan, Komi A.S.S.R., and Turkmenistan. The older and established petroleum regions of Azerbaydzhan, the North Caucasus, and Soviet Central Asia could not produce more petroleum than they produced in 1975.

The entire growth in oil production during the 1976–80 period is to be accounted for by the eastern regions of the country, particularly the fields in western Siberia and on Mangyshlak Peninsula, which are to provide about three-fourths of the 1976–80 production. Production of petroleum in western Siberia is slated to increase from 148 million tons in 1975 to 300 million to 310 million tons in 1980. In 1976–80, about 30 new oilfields are to be put into operation, and new capacities for collecting and preparing crude oil are to be built.

Development of large oil-producing regions calls for the construction of crude oil trunk pipelines. Completion of about 15,000 kilometers of crude oil and 3,500 kilometers of product pipelines is required for the 1976–80 period. This represents 33% of the total pipeline length built in all the years before 1976.

Refining of crude oil is to increase 25% to 30% in 1980 over that of 1975. One of the basic measures of the 1976–80 plan is construction and completion of combined enlarged units with an average primary distillation capacity of 6 million tons per year instead of 2 million to 3 million tons per year as earlier planned; an average catalytic reforming capacity of 0.6 million to 1 million tons, instead of 0.3 million tons; an average dewatering capacity of up to 2.6 million tons instead of 1.2 million tons; and an average coking capacity of 1.5 million tons instead of 0.6 million tons. It is planned to complete and enlarge the following refineries: Achinsk, Tobolsk, Tomsk, Lisichansk, Pavlodar, Mažeikiai, and Chardzhou. It is also planned to build the new large Nakhodka refinery during 1976–80.

The actual and planned growth in Soviet production of crude oil is shown in table 11.

Table 11.—U.S.S.R.: Production of crude oil (including gas condensate), by region, in 1970, 1975, and 1980

Region	Actual				Planned	
	1970		1975		1980	
	Million metric tons	Percent	Million metric tons	Percent	Million metric tons	Percent
European U.S.S.R. and Urals:						
Tatarstan, Bashkiria, Kuybyshev Oblast	176.1	r 49.8	178.4	36.3	142.3	r 22.3
Perm Oblast	16.1	4.6	22.3	4.5	31.0	r 4.8
Komi A.S.S.R. and Arkhangelsk Oblast	7.6	2.2	11.1	2.3	25.0	3.9
Other	90.0	25.5	87.6	17.9	87.3	13.6
Total	289.8	82.1	299.4	61.0	285.6	44.6
Asian U.S.S.R.:						
Western Siberia	31.4	r 8.9	148.1	30.2	308.0	r 48.1
Kazakhstan	13.1	3.7	23.8	4.9	27.0	r 4.2
Turkmenistan	14.4	4.1	15.3	3.1	13.7	r 2.1
Other	4.3	1.2	3.9	.8	5.7	1.0
Total	63.2	17.9	191.1	39.0	354.4	55.4
Grand total	353.0	100.0	[1] 490.5	100.0	[2] 640.0	100.0

r Revised.
[1] Figure differs from that given elsewhere in this chapter owing to a difference in source.
[2] Plan and supplementary target.

Source: Khimiya i tekhnologiya topliv i masel (Chemistry and Technology of Fuels and Lubricants), Moscow. No. 1, January 1977, pp. 6–9.

Based on signed trade agreements and the latest Soviet forecasts, crude oil and petroleum product exports from the U.S.S.R. are expected to increase from 130.4 million tons in 1975 to 175 million tons in 1980. Exports to market economy countries will probably grow from 52.6 million tons in 1975 to 75 million tons in 1980.

Exports from the U.S.S.R. to other centrally planned economy countries will continue to grow, perhaps attaining 100 million tons per year by 1980. Deliveries of crude oil to CMEA countries increased from 138 million tons in 1966–70 to 228 million tons in 1971–75, about 94% of the planned goal of 243 million tons. The U.S.S.R. is to supply 364 million tons of crude oil to other CMEA countries during the 1976–80 period, 60% more than in the past 5 years. In light of Soviet moves to step up oil sales in the West to offset the cost of Western technology imports, it is possible that the U.S.S.R. will not deliver in 1976–80 all of the amounts of crude oil for which CMEA countries contracted. The Soviets are also facing a situation of tighter domestic petroleum supplies.

The 1975 price for Soviet crude oil deliveries to CMEA countries was set at a level about 130% above that charged during 1971–74. The price may rise by one-third in 1977, compared with the planned increase of 8% in 1976.

Exports of crude oil and petroleum products to European CMEA countries are shown in table 12.

Table 12.—U.S.S.R.: Exports of crude oil and petroleum products to CMEA nations in Eastern Europe

(Million metric tons)

	Czechoslovakia	Poland	Bulgaria	East Germany	Hungary	Total
1960:[1]						
Crude oil	2.4	0.7	--	1.8	1.4	6.3
Petroleum products	.3	1.4	0.8	.4	.1	3.0
Total	2.7	2.1	.8	2.2	1.5	9.3
1965:[1]						
Crude oil	6.0	3.2	2.1	4.9	2.0	18.2
Petroleum products	.4	1.5	1.3	.5	.4	4.1
Total	6.4	4.7	3.4	5.4	2.4	22.3
1970:						
Crude oil [e]	[r] 9.8	[r] 7.1	[r] 5.5	8.8	[r] 4.3	[r] 35.5
Petroleum products [e]	[r].7	[r] 1.5	[r] 1.5	.5	[r].5	[r] 4.7
Total[1]	10.5	8.6	7.0	9.3	4.8	40.2
1975:						
Crude oil [e r]	14.9	12.0	9.9	15.0	6.9	58.7
Petroleum products [e r]	1.1	1.3	1.7	--	.6	4.7
Total[1]	16.0	13.3	11.6	15.0	7.5	63.4
1980: [e]						
Crude oil [r]	20.0	18.4	14.8	19.6	9.9	82.7
Petroleum products [r]	1.0	1.0	1.7	--	.6	4.3
Total	21.0	19.4	16.5	19.6	10.5	87.0

[e] Estimate. [r] Revised.
[1] Vneshnyaya torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. 1960, 1965, 1970, and 1975.

The average growth of crude oil extraction in the western Siberian oilfields since exploitation began in 1969 was 23 million tons per year. In 1976, the Samotlor field accounted for 55% of the total annual production and the Fëdorov field accounted for 26%. Every year, more than 1,000 wells with an average depth of 2 to 2.5 kilometers are drilled in western Siberia. By 1980, there are to be about 40 developed oilfields in operation. In 1976, western Siberia produced 182 million tons. The planned target for 1977 is 214.5 million tons, which has good prospects for achievement. By 1980, this region is to produce 308 million tons of petroleum.

Soviet crude oil and petroleum products statistics are presented in table 13.

Table 13.—U.S.S.R.: Salient petroleum statistics [1]

(Million metric tons)

	Actual					Forecast	
	1960	1965	1970	1975	1976	1980	1985
Crude oil (including gas condensate):							
Domestic output	147.9	242.9	353.0	491.0	519.7	r 610	690
Of which, gas condensate	1.2	2.8	5.0	8.0	8.0	r 10	13
Imports	1.2	--	3.5	6.5	6.4	10	10
Exports:							
To centrally planned economy countries	8.8	22.9	r 39.1	r e 68.5	e 74.5	r 90	120
To market economy countries	9.0	21.0	r 24.8	r e 24.6	e 36.3	r 40	40
Total	17.8	43.9	63.9	93.1	110.8	130	160
Crude product conversion:							
Crude oil to refineries	131.3	199.0	292.6	404.4	414.2	r 490	540
Yearend annual refinery capacity e	153.0	225.0	295.0	380.0	395.0	475	520
Petroleum products:							
Output from crude e	130.0	169.0	250.0	344.0	352.0	r 415	460
Imports	3.2	1.9	1.1	1.1	.8	1	1
Exports:							
To centrally planned economy countries	6.4	6.5	r e 8.0	r e 9.3	e 9.5	r 10	11
To market economy countries	9.0	14.5	r 21.0	r e 28.0	e 28.2	r 35	39
Total	15.4	21.0	29.0	37.3	37.7	45	50
Apparent consumption	117.8	149.9	222.1	307.8	315.1	r 371	411

e Estimate. r Revised.

[1] Production data are from: National Economy of the U.S.S.R., Moscow. 1960, 1965, 1970, and 1975; and Pravda, Moscow. Jan. 23, 1977, p. 1. Trade data are from: Vneshnyaya torgovlya S.S.S.R. (Foreign Trade of the U.S.S.R.), Moscow. 1960, 1965, 1970, 1975, and 1976. Data may differ from those given elsewhere in this chapter owing to a difference in source.

The Mineral Industry of the United Arab Emirates

By Candice Stevens [1]

On December 2, 1971, the United Arab Emirates officially became a sovereign Federal State comprising seven former Trucial Coast sheikdoms coexisting under a provisional constitution for an initial period of 5 years. On December 2, 1976, the seven emirates—Abu Dhabi, Ajman, Dubai, Fujairah, Ras al-Khaimah, Sharjah, and Umm al-Qaiwain—opted to extend the life of the provisional constitution for an additional 5 years. The drafting of a permanent constitution was thwarted by disagreement regarding the degree of central government authority over the individual emirates and the appropriate contribution of each emirate to the federal budget. Under the provisional charter, the emirates continued to maintain strict independence in oil policy and exercised individual control over internal budgets.

In 1976, the economy of the United Arab Emirates remained almost entirely dependent on the petroleum industry which contributed more than 95% of total Government revenue. Petroleum income of the three oil-producing emirates—Abu Dhabi, Dubai, and Sharjah—amounted to $5.6 billion,[2] a 17% increase over 1975 earnings. The development program for 1976 prepared by the United Arab Emirates Ministry of Trade and Economy calculated overall expenditures in the emirates at $5.68 billion. The largest allocation of $1.7 billion was for various development projects, followed by $1.5 billion in general expenditures. Foreign aid comprised $1.2 billion of the United Arab Emirates expenditure. This was channelled primarily through the Abu Dhabi Fund for Arab Economic Development (AFAED), established in July 1971 to aid other Arab countries through loans, grants, or direct participation in projects. The 1976 federal budget of the United Arab Emirates was $1.2 billion of which approximately 95% was contributed by Abu Dhabi.

Both Abu Dhabi and Dubai, the largest oil producers and the wealthiest of the emirates, were to use their petrodollars in the construction of complete industrial cities. In 1976, Dubai awarded various design and construction contracts for the free zone city of Jebel Ali, situated about 17 kilometers from the city of Dubai. Among the projects envisaged for the area were an aluminum smelter, a natural gas liquefaction facility, a steel plant, a fertilizer plant, a petroleum refinery, and a deepwater port. In Abu Dhabi, the Arthur D. Little Co. (United States) completed a feasibility study for the industrialization of Ruweis, situated 160 kilometers to the west of the city of Abu Dhabi near the crude loading facility at Jebel Dhanna. The essential elements in this scheme, apart from a new port and airport, would be a natural gas liquefaction facility, a petroleum refinery, an ammonia/urea plant, an iron and steel pelletization plant, and a petrochemical complex.

A geological survey completed in 1976 for the Ministry of Petroleum and Natural Resources by Hunting Geology and Geophysics Ltd. (United Kingdom) [3] in-

[1] Economist, International Data and Analysis.
[2] Where necessary, values have been converted from United Arab Emirates dirhams (UAED) to U.S. dollars at the rate of UAED3.94 = US$1.00.
[3] Hunting Geology and Geophysics, Ltd. Geological Survey of the United Arab Emirates Northern Emirates. London, 1976, 88 pages.

dicated important zones of copper and chromite mineralization. The survey, which covered 11,500 square kilometers of the northern emirates, also identified potential commercial deposits of industrial minerals, including gypsum, talc, dolomite, and salt. Priority areas scheduled for further investigation were two copper occurrences, one south of Wadi Ham and the other on Fujairah's east coast, and the chromite deposits at Manama, Shawkah, and Siji.

PRODUCTION

Petroleum production increased approximately 16% from 1,663,800 barrels per day in 1975 to 1,936,400 barrels per day in 1976. Abu Dhabi remained the largest producer with output increasing 14% to nearly 1.6 million barrels per day. The other two producing emirates were Dubai (313,400 barrels per day) and Sharjah (37,000 barrels per day). Reserves in the three emirates were estimated at 31.2 billion barrels. Exploration continued both onshore and offshore and showed considerable promise in the producing emirates as well as Fujairah and Ras al-Khaimah.

At the December 1976 meeting of the Organization of Petroleum Exporting Countries (OPEC), Abu Dhabi followed Saudi Arabia in adopting the minority 5% increase in the price of oil exported. Dubai and Sharjah, although not members of OPEC, similarly increased their crude prices by 5%. No decision was reached concerning the price of exports from the El Bunduq Field, which was shared equally by Abu Dhabi and Qatar. Abu Dhabi ordered no major increase in oil output other than a previously planned alteration in the production ceiling for its offshore fields to meet natural gas requirements.

Marketed gas production in 1976 was approximately 1.2 billion cubic meters in Abu Dhabi and 0.8 billion cubic meters in Dubai. Gas reserves in Abu Dhabi, Dubai, and Sharjah were estimated at 637 billion cubic meters. The only other mineral commodity produced in quantity in 1976 was cement for use by local construction industries.

Table 1.—United Arab Emirates: [1] Production of mineral commodities [2]

Emirate, commodity and unit of measure	1974	1975	1976 [p]
ABU DHABI			
Gas, natural:			
Gross production ---million cubic feet--	460,995	432,002	503,000
Marketed production [3] ---do---	42,377	38,493	[e] 40,000
Petroleum, crude ---thousand 42-gallon barrels--	[r] 514,504	500,488	578,890
AJMAN			
Marble ---square meters--	[e] 26,000	NA	NA
DUBAI			
Gas, natural:			
Gross production [e] ---million cubic feet--	101,000	102,000	127,600
Marketed production [e] ---do---	19,000	20,000	20,000
Petroleum, crude ---thousand 42-gallon barrels--	[r] 88,148	92,856	114,391
SHARJAH			
Gas, natural:			
Gross production ---million cubic feet--	9,000	15,000	15,000
Marketed production ---do---	(4)	(4)	(4)
Petroleum, crude ---thousand 42-gallon barrels--	[r] 10,038	13,943	13,505

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the emirates listed, there are three others: Fujairah, Ras al-Khaimah, and Umm al-Qaiwain; these record no mineral production but presumably produce small quantities of crude construction materials.

[2] In addition to the commodities listed, crude construction materials such as common clays, stone, sand, and gravel presumably are produced, but output is not recorded quantitatively and general information is inadequate for formulation of reliable estimates of output levels.

[3] Includes gas reinjected to reservoirs, if any.

[4] No marked production reported; there probably is some small field use.

TRADE

Mineral trade consisted primarily of crude oil exports and imports of refined petroleum products and construction materials. The primary recipients of the United Arab Emirates' oil exports continued to be Japan, France, the United Kingdom, the United States, and the Federal Republic of Germany. Although the United Arab Emirates imported goods from 85 or more countries in 1976, the vast bulk of imports emanated from Western Europe, Japan, and the United States. During 1976, the United Arab Emirates imported approximately 9 million barrels of processed petroleum products from Iran, Kuwait, and other Persian Gulf countries. The imported products consisted of fuel oil (5,545,000 barrels), motor gasoline (1,900,000 barrels), jet fuel (1,455,000 barrels), and kerosine (135,000 barrels).

Increased congestion at the United Arab Emirates' terminals was to be relieved by the expansion of existing facilities and the construction of six new ports. In Abu Dhabi, tenders were issued for the extension of port facilities at Mina Zayed by the addition of five deepwater berths. A construction contract was also awarded to the South Korean Dong Ah Construction Ind. Co., Ltd., for the construction of a complete new port alongside Mina Zayed. The project, estimated to cost $609 million, was to consist of 34 general cargo berths with container facilities. Another deepwater port comprised of 12 general cargo berths was planned for the industrial city of Ruweis.

In Dubai, a $210 million contract was awarded to Costain-Taylor Woodrow (United Kingdom) for the extension of Port Rashid, Dubai's artificial deepwater harbor completed in 1972. The agreement provided for over 5 kilometers of breakwaters, 22 new cargo berths, transit sheds, and other port facilities. The construction of the Dubai drydock complex, also by Costain-Taylor Woodrow under the direction of Sir William Halcrow and Partners, continued on schedule. The largest dock of 525 meters was to accommodate tankers of 1 million deadweight tons, while three smaller docks would have 500,000- or 350,000-deadweight-ton capacities. A deepwater port planned for Jebel Ali, the new free zone industrial area, was expected to be one of the largest in the gulf at its completion in 1980. The port design provided for 74 berths, accommodating ships up to 90,000 deadweight tons laden and 150,000 deadweight tons unladen. Dredging of the ports was to be carried out by Gulf Cobla, a joint venture of Costain-Blankevoort International Dredging and Dubai Transport; the construction of breakwaters and other civil engineering work was to be handled by Balfour Beatty Construction and Al Futtaim-Wimpey.

In Sharjah, an intermodal transportation system, "Sharjahport," was to comprise specialized container terminals at two ports linked to a fully containerized airport handling facility. The first two container berths in the gulf were completed at Port Khalid in August 1976. The contractors—Archirodon S.A. (Greece), Hochtief AG (West Germany), and Six Construct (Belgium)—were to provide five additional general cargo berths. A second deepwater port was under construction at Khor Fakkan on the east coast to provide transoceanic container ships an alternative to passing through the congested Straits of Hormuz. Both ports were to be managed by Seatrain Gulf S.A., a subsidiary of the U.S. container and shipping company, Seatrain Lines Inc.

Umm al-Qaiwain also contracted for port expansion in 1976. The construction of a 300-meter-long pier and a deepening of the main port to 7.5 meters was to be completed in May 1977. In Ras al-Khaimah, construction began on the Khor Kuwait deepwater port by Contracting and Trading Co. (CAT) of Lebanon and Archirodon S.A.

COMMODITY REVIEW

METALS

Aluminum.—Plans were finalized for the construction of the aluminum smelter in Jebel Ali by the Dubai Aluminium Co. (DUBAL), owned 80% by the Dubai Government, 7.5% by Southwire Aluminum Co. (United States), 7.5% by Nissho-Iwai Co., Ltd. (Japan), and 5% by various local interests. Financing for the

$500 million smelter was to be managed in large part by Morgan Grenfall & Co. and Lloyds Bank International, both of the United Kingdom. The smelter was to commence production in 1979 with an initial output of 20,000 tons per year rising to 135,000 tons per year by 1981. British Smelter Construction Ltd. (BSCL) was contracted for construction work and John Brown Engineering Gas Turbines Ltd. (United Kingdom) was to supply gas turbine generators and associated equipment. Power requirements were estimated at 60 million cubic feet per day of natural gas from Dubai's offshore Fateh Field. Southwire and Nissho-Iwai signed 12-year contracts to purchase 80% of the smelter's output with the balance to go to local industries including a 3,000-ton-per-year extrusion plant also to be constructed by BSCL.

Iron and Steel.—A direct reduction steel mill was planned for the new industrial city at Ruweis in Abu Dhabi. The plant, which was scheduled for completion in 1980, would have an initial capacity of 400,000 tons per year; design plans also provided for the construction of a second unit of the same capacity to be completed in an additional 4 years. The Abu Dhabi Government and Kobe Steel, Ltd. (Japan), concluded an investment sharing agreement, which provided for Abu Dhabi to cover 70% of the $200 million construction cost and Kobe Steel to provide the balance of the financing. However, this agreement was negated at yearend 1976, and the project was opened to bids from other potential foreign partners.

NONMETALS

Cement.—To meet heavy demands from the United Arab Emirates construction industries, expansion programs were planned at existing cement plants and four new facilities were in various stages of development. In Abu Dhabi, the Al Ain cement plant, which went onstream in May 1976 with a 600-ton-per-day capacity, was scheduled for an increase in output. The plant was constructed by Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI), at a total cost of $30.4 million. The Ittihad Cement Co., operators of the Al Ain facility, contracted for a second cement plant by IHI. The $68.3 million plant, due for completion in 1979, was to produce 1,500 tons of cement per day.

The construction of the Dubai national cement plant by Costain Civil Engineering (United Kingdom) continued on schedule with startup planned for mid-1978. During the year, Dubai awarded Costain an additional $12 million contract for the installation of various types of equipment to be designed and supplied by F.L. Smidth (United Kingdom).

In Ras al-Khaimah, construction was in progress for doubling the capacity of the Union Cement Co. plant by the addition of a duplicate kiln. The plant, which was under the management of Norcem Co. of Norway, was to produce 1,400 tons of portland cement per day by yearend 1977. The construction of a second cement plant with a 700-ton-per-day capacity was to begin in January 1977. The plant was to be built by Mothercat Ltd. (United Kingdom and Lebanon) at a cost of $20 million and to be completed in 1978.

In Sharjah, a 700-ton-per-day cement plant was due to come onstream in 1977. Construction of the $25 million plant was by Six Construct of Belgium, with management to be provided by Associated Portland Cement.

Fertilizer Materials.—The Abu Dhabi National Oil Co. (ADNOC) commissioned Snam Progetti, a subsidiary of Ente Nazionale Idrocarburi (ENI), to undertake a feasibility study of a fertilizer complex for the Ruweis industrial area. The plant, which would use natural gas from Abu Dhabi's onshore fields as feedstock, was to produce 2,000 tons of ammonia and 1,500 tons of urea daily. The feasibility study was to include an analysis of the world fertilizer market and an appraisal of necessary infrastructure. Abu Dhabi also entered into negotiations with the Indian Government concerning a joint venture for the construction of a second fertilizer plant to supply Indian markets.

MINERAL FUELS

Energy.—Of the 1976 federal budget, $83 million was applied to the execution of electric power projects undertaken by the Ministry of Electricity and Water. A number of mobile diesel generators and 33 other electric power units, representing an overall power potential of 45.3 megawatts,

were to be imported, assembled, and distributed throughout the emirates. In addition, Abu Dhabi planned the installation of four generating facilities at Umm al Nar with a total capacity of 240 megawatts, a large electric generating plant at Port Zayed with an output of 1,400 megawatts, and three electric generators at Al Ain raising the capacity of that power station to 120 megawatts. Other electric power projects scheduled for 1977 were the construction of three thermal power units of 60 megawatts capacity at Jebel Ali, Dubai, by Mitsubishi Heavy Industries, Ltd. (Japan); a 50-megawatt power station in Ras al-Khaimah by Kier International (United Kingdom); and an electric powerplant in Umm al-Qaiwain with a total capacity of 15 megawatts. These projects would make a combined addition of 2,030 megawatts to the installed generating capacity of the United Arab Emirates.

Natural Gas.—In March 1976, Abu Dhabi formally nationalized its natural gas reserves. From that date, all gas reserves discovered in Abu Dhabi, both associated and nonassociated with oil, together with all gas produced from oil and gas wells, were to be the exclusive property of the State. The decree also provided for ADNOC to have all rights to gas exploitation, either alone or in joint ventures where ADNOC retained a minimum 51% shareholding.

Startup of the Das Island natural gas facility under construction by the Abu Dhabi Gas Liquefaction Co. Ltd. (ADGLIC) was delayed until mid-year 1977. Designed to utilize 550 million cubic feet per day of associated gas from the offshore Umm Shaif, Zakum, and El Bunduq Fields, the plant was to produce 15 million barrels of liquefied natural gas (LNG), 5.6 million barrels of liquefied petroleum gas (LPG), 1.5 million barrels of light distillate, and 1.6 million barrels of pelletized sulfur per year. The entire production of LNG and LPG was earmarked for the Tokyo Electric Power Inc. which concluded a new agreement with Abu Dhabi during the year. The two parties agreed to relate the price of LNG to the landed price of crude oil imported into Japan with full equivalence achieved in stages over the course of 3 years. Under the original supply contract signed in 1972, the price for delivery of LNG was set at $1 per million Btu; the new formula provided for an initial price of $2 per million Btu. The new arrangements were expected to increase revenues from deliveries to Tokyo Electric Power from $2 to $6 billion over the 20-year contract period.

Negotiations continued between ADNOC and the foreign partners in the Abu Dhabi Petroleum Co. (ADPC) regarding the scheme to process associated gas from Abu Dhabi's onshore fields. It was estimated that up to 185,000 barrels per day of natural gas liquids could be extracted from associated gas from the Bab, Bu Hasa, and Asab oilfields. In April 1976, ADPC signed an agreement with the Government to form a company on a 60/40 basis with ADNOC having the same 60% shareholding as in ADPC. With borrowed funds accounting for 75% of the capital for the project, the foreign companies would be obligated to contribute 10% of the equity. However, at yearend, the Abu Dhabi Government and the companies concerned, which included British Petroleum Co., Ltd. (BP), Compagnie Française des Pétroles (CFP), Shell International Petroleum Co., Ltd., Exxon Corp., and Mobil Oil Corp., had not completed the details of the financing arrangement.

In Dubai, plans were being concluded for the construction of a $120 million gas processing plant at Jebel Ali. Sunningdale Oils Ltd. of Canada was to construct the plant and market all output, expected to total 4 million barrels per year of natural gas liquids.

Table 2.—Oilfields of the United Arab Emirates in 1976

Location	Oilfield and discovery date	Company	Date of first production	Rate of production (average barrels per day)	Gravity (°API)	Sulfur content (percent)
Abu Dhabi:						
Onshore	Asab, 1964	Abu Dhabi Petroleum Co., Ltd	1973	420,000	40.0	0.7
	Bab, 1960	----do	1963	90,000	39.0	.7
	Bu Hasa, 1960	----do	1962	500,000	40.0	.7
	Sahil, 1970	----do	1975	10,000	--	.7
Offshore	Abu Al Bu Koosh, 1973	Abu Al Bu Koosh Oil Co., Ltd	1974	80,000	32.1	1.7
	Arzanah, 1973	Amerada Hess Corp	--	--	45.0	1.0
	El Bunduq, 1964	El Bunduq Co	1976	20,000	38.5	1.1
	Mubarraz, 1969	Abu Dhabi Oil Co., Ltd	1973	20,000	38.1	.9
	Saath al-Razboot, 1969	Abu Dhabi National Oil Co	--	--	--	--
	Umm Shaif, 1958	Abu Dhabi Marine Areas, Ltd	1962	200,000	37.6	1.4
	Zakum, 1964	----do	1967	250,000	40.1	1.0
Dubai:						
Offshore	Fateh, 1966	Dubai Marine Areas, Ltd	1969	185,000	31.6	1.7
	S.W. Fateh, 1970	----do	1972	130,000	32.5	1.7
	Rashid, 1973	----do	--	--	37–40	--
Sharjah:						
Offshore	Mubarek, 1972	Crescent Petroleum Co	1974	37,500	37.0	.6

Petroleum.— *Abu Dhabi.*—In 1976, the Government-owned ADNOC maintained its 60% participation in major oil operation and announced it would assume full responsibility for developing new offshore oilfields. ADNOC scheduled a change in offshore production ceilings which were first imposed in 1974 for conservation purposes. Allowable output for the offshore fields operated by Abu Dhabi Marine Areas, Ltd. (ADMA) was to rise progressively quarter by quarter through 1977 to reach 580,000 barrels per day in the last quarter as compared with 450,000 barrels per day in 1976. The additional output was intended to provide sufficient associated gas to feed the gas liquefaction plant under construction on Das Island. Allowable output for the onshore fields operated by the ADPC was to remain at the 1976 level of 1,035,000 barrels per day.

ADNOC once again concluded new marketing arrangements with its operating oil companies for the coming year. In 1976, the production split was 40% equity, 30% buyback, and 30% State crude oil; in 1977, equity was to remain at 40%, but buyback was to be cut to 20%, with ADNOC increasing its offtake to 40% of crude oil production. In addition, buyback arrangements were to be converted to regular commercial deals with each equity holding company under those contractual terms applicable to other direct sale customers. ADNOC's emphasis in crude oil sales was on long-term contracts of 4 to 5 years duration and on the sale of oil on a delivered basis in an attempt to secure employment for its two tankers, the *al-Dhafra* and the *al-Dalma*. One agreement was concluded with Japan's Idemitsu Petrochemical Company Limited for the purchase of 20,000 barrels of crude oil per day in early 1977 increasing to 60,000 barrels per day by the end of the 5-year contract period, with provisions for cooperation in the tanker business. Overall, ADNOC's sale of crude oil to Japanese refiners was expected to double in 1977 to 160,000 barrels per day, as negotiations continued with other Japanese buyers, including Japan Line Ltd., Mitsubishi Oil Co., Ltd., Showa Oil Co., Ltd., and C. Itoh & Co., Ltd.

Onshore, ADPC continued development drilling and water injection programs designed to raise production capacity in its four fields to 1.4 million barrels per day by yearend 1978. Production from the Bab, Bu Hasa, and Asab Fields was supplemented by a 10,000-barrel-per-day flow from the new Sahil Field to raise total output to 1,020,000 barrels per day in 1976. The fields were spread over a wide area approximately 200 kilometers from the city of Abu Dhabi and were linked by pipeline to the loading facilities at Jebel Dhanna.

Offshore, a total of 11 rigs were engaged in the ADMA concession, drilling new injection and production wells, maintaining existing wells, and continuing delineation and exploration. In 1976, the Umm Shaif and Zakum Fields averaged 450,000 barrels per day, a 6% increase over the 1975 level. Additional production in 1977 was to come entirely from the Umm Shaif Field, the site of an extensive water injection scheme intended to raise output from 200,000 to 330,000 barrels per day. The new supercomplex, which comprised an oil and gas production plant in addition to water injection facilities, was built under the supervision of BP at a cost of $110 million. A similar water injection scheme was planned for the neighboring Zakum Field and was expected to come into operation within 2 years.

Abu Dhabi's four other offshore oilfields were in various stages of development in 1976. The Abu Al Bu Koosh Field, operated by a consortium including Sunningdale Oils Ltd., and Amerada Hess Corp., evidenced a 17.5% increase in output from 66,000 barrels per day in 1975 to nearly 80,000 barrels per day in 1976. Production at the smaller Mubarraz Field, operated by the Japanese consortium Abu Dhabi Oil Co., Ltd. (ADOC), remained at the 1975 level of 20,000 barrels per day. The El Bunduq Field, owned jointly by BP, CFP, and United Petroleum Development of Japan, was inaugurated in February 1976 at an initial rate of 20,000 barrels per day due to rise to 30,000 barrels per day in early 1977. Four wells were completed in the Amerada Hess group's Arzanah Field with commercial production to begin in mid-1977. The group first tested the 1973 discovery at a rate of 4,000 barrels per day of 45°API gravity, 1.0% sulfur crude oil.

In 1976, ADNOC entered into a 50/50 joint venture with CFP to develop two offshore oilfields originally discovered by ADMA. The Saath al-Razboot Field, situated about 130 kilometers off Abu

Dhabi, was to begin production in 1979 at a rate of 100,000 barrels per day expected to decline after a few years to 80,000 barrels per day. The Upper Zakum Field, which was to remain under ADMA operation until 1978, was to reach a production level of 500,000 barrels per day within 6 to 8 years. A new terminal to be built 61 kilometers east of Zakum Field on Zirka Island would handle crude from the two fields.

ADNOC's 15,000-barrel-per-day refinery at Umm al-Nar Island came onstream in May 1976. Constructed by Kellogg Company (United States) at a cost of $35 million, the refinery processed crude pumped through a 120-kilometer pipeline from Abu Dhabi's onshore fields. Plans were being considered for the expansion of capacity to 50,000 barrels per day.

Bids were invited for the construction of a second refinery in the Ruweis industrial zone. The preliminary feasibility study and market survey for the refinery was completed during the year by the French group BEICIP. Production of the refinery, which was to rise from an initial 120,000 to 240,000 barrels per day, was to include fuels, oil, asphalt, and other products to meet the United Arab Emirates domestic demand. It was estimated that the refinery would require 3½ years for completion at a cost of $500 million.

Ajman.—No exploration activity was reported in 1976 by Occidental Petroleum Corp., the only concession holder in Ajman's offshore.

Dubai.—Development drilling continued throughout 1976 in the offshore Fateh and Southwest Fateh Fields owned by the Dubai Petroleum Co. (DPC). At the beginning of the year, the Fateh Field Mishrif water injection plant was brought up to design output and was injecting approximately 250,000 barrels of water per day. A water injection scheme in the Southwest Fateh Field was in partial operation in late 1976 and was scheduled for completion in 1977. The two fields, linked by a 16-kilometer pipeline, averaged 315,000 barrels of crude per day in 1976, a 20% increase over the 1975 level. Delineation drilling was planned for the Rashid discovery area, about 24 kilometers south of Fateh, which previously tested oil and gas in significant quantities.

The 1 Falah well, situated 24 kilometers west of the Fateh Field, was drilled by DPC at yearend 1976. The dual zone discovery was completed at 9,630 feet and yielded a 2,500-barrel-per-day combined flow. The upper zone at 8,000 feet tested 25.4° API gravity oil and the lower zone at 8,760 feet yielded 47.1° API gravity oil. The well was drilled by a Rowan International rig which was to drill another prospect in DPC's 3,360-square-kilometer concession area in 1977.

Fujairah.—Reserve Oil and Gas Co. (United States), which held a 1,500-square-kilometer concession in the Gulf of Oman, was to resume exploratory drilling after a hiatus of many years. The NBR–1 was to be drilled in 300 feet of water approximately 18 kilometers off Fujairah's east coast.

Ras al-Khaimah.—Deutsche Schactbau und Tiefbohrgesellschaft (Federal Republic of Germany) replaced Vitol Exploration B.V. (Netherlands) as the operator for a multinational exploration group in a 2,330-square-kilometer offshore concession area. In 1976, the 1 R.A.K. wildcat drilled 37 kilometers offshore, tested 4,000 barrels per day from two zones. The Government agreed to take a 50% working interest in a venture to exploit the discovery, which lies between Sharjah's Mubarek Field and the Henjan discovery in Iranian waters. The group planned to spud a second wildcat 24 kilometers to the northeast at yearend.

Onshore, Norsk Hydro A/S relinquished its 1,700-square-kilometer concession after a 3-month seismic program proved unsuccessful.

Sharjah.—The rewards from Sharjah's oil operation have been small compared with Abu Dhabi and Dubai owing to the need for revenue sharing and difficult working conditions that caused a decline in production in 1976. An agreed formula provided for oil revenue from the offshore Mubarek Field to be divided among Iran, Umm al-Qaiwain, and Sharjah (which received 35%). The field, which came into production in July 1974, was scheduled to attain an output of 60,000 barrels per day. However, technical difficulties caused by the depth of the reservoir and other geological features have kept production at a maximum of 38,860 barrels per day (1975), which declined to 37,500 barrels per day

in 1976. Output was sold directly to the shareholders in the Crescent Petroleum Co., with the major part of production marketed in the United States and Japan.

During 1976, Crescent Petroleum relinquished a quarter of its 2,000-square-kilometer concession area around Abu Musa Island to Houston Oil and Minerals (United States), which completed seismic studies and was expected to commence drilling in 1977. The only other concession offshore was held by Reserve Oil and Gas Co., who was also planning to start exploratory drilling in 1977.

Onshore, Crystal Oil Co. relinquished its 1,400-square-kilometer concession area in western Sharjah owing to high drilling costs. Exploration rights in this area were acquired by Pinnacle Gas and Oil/Nicklos Drilling (United States). The agreement provided for the first well to be drilled within 10 months with the two companies investing $12 million in the first 3 years of prospecting and drilling to depths of not less than 16,000 feet. In the event of a commercial discovery, Sharjah was to receive 55% of oil revenues and 16.65% of duties on oil and gas, with the right to 60% partnership in the company within 3 months of the discovery.

Umm al-Qaiwain.—Exploration continued in 1976 offshore by both the Umm al-Qaiwain Oil Group, with Zapata Exploration Co. (United States) as operator, and United Refining Co. Occidental Petroleum retained its claim to its offshore concession area but no activity was reported. Onshore, Houston Oil and Minerals was awarded the entire land concession area during the year.

Table 3.—Concessions held in the United Arab Emirates during 1976

Location	Company	Ownership (percent)	Nationality of company	Area (square kilometers)
Abu Dhabi:				
Onshore	Abu Dhabi Petroleum Co., Ltd. (ADPC) operator:			
	Abu Dhabi National Oil Co. (ADNOC)	60.00	United Arab Emirates	40,000
	British Petroleum Co., Ltd. (BP)	9.50	United Kingdom	
	Compagnie Française des Pétroles (CFP)	9.50	France	
	Near East Development Corp.:			
	Exxon Corp. (Exxon)	4.75	United States	
	Mobil Oil Corp. (Mobil)	4.75	----do	
	Shell International Petroleum Co., Ltd	9.50	United Kingdom and Netherlands	
	Portuguese Participations and Explorations Corp. (PARTEX)	2.00	Portugal	
Offshore	Abu Al Bu Koosh Oil Co., Ltd.:			
	CFP operator	51.00	France	109
	New England Petroleum Co. (NEPCO)	24.50	United States	
	Amerada Hess Corp	12.25	----do	
	Sunningdale Oils Ltd	12.25	Canada	
Do	Abu Dhabi Gas Liquefaction Co., Ltd. (ADGLC):			
	ADNOC	51.00	United Arab Emirates	30,080
	Mitsui & Co., Ltd	22.10	Japan	
	BP	16.30	United Kingdom	
	CFP	8.20	France	
	Bridgestone Liquefied Gas Co., Ltd	2.40	Japan	
Do	Abu Dhabi Marine Areas, Ltd. (ADMA) operator:			
	ADNOC	60.00	United Arab Emirates	31,080
	BP	14.67	United Kingdom	
	CFP	13.33	France	
	Japan Oil Development Co., Ltd	12.00	Japan	
Do	Abu Dhabi Oil Co., Ltd. (ADOC):			
	ADNOC	51.00	United Arab Emirates	4,416
	Maruzen Oil Co., Ltd	49.00	Japan	
	Daikyo Oil Co., Ltd		----do	
	Nippon Mining Co., Ltd		----do	
Do	Amerada Hess Corp. of Abu Dhabi operator:			
	Amerada Hess Corp	31.50	United States	NA
	Pan Ocean Oil Corp	31.50	United Kingdom	
	Bow Valley Industries Ltd	20.00	Canada	
	Wingate Enterprises	12.00	United Kingdom	
	Houston Oil Canada	5.00	Canada	
Do	El Bunduq Co. (ADMA operator):			
	BP	33.33	United Kingdom	NA
	CFP	33.33	France	
	United Petroleum Development Co., Ltd	33.33	Japan	
Do	Sunningdale Oils Ltd	100.00	Canada	2,820

Ajman:				
Offshore	Occidental Petroleum Corp	100.00	United States	NA
Dubai:				
Onshore	Texas Pacific Dubai Inc	50.00	----do	4,177
	Union Texas Dubai Inc	25.00	----do	
	Louisiana Land and Exploration Co	12.50	----do	
	Quintana Dubai Inc	7.50	----do	
	Natomas of Dubai Inc	5.00	----do	
Offshore	Dubai Petroleum Co. (DPC):			
	Continental Oil Co. (CONOCO) operator	30.00	----do	3,360
	Dubai Marine Areas, Ltd. (DUMA):			
	CFP	25.00	France	
	Hispanico de Pétroleos S.A. (Hispanoil)	25.00	Spain	
	Deutsche Texaco A.G. (Texaco)	10.00	United States	
	Dubai Sun Oil Co	5.00	----do	
	Delfzee Dubai Petroleum NV (Wintershall AG)	5.00	West Germany	
Do	Sunningdale Oils Ltd	100.00	Canada	3,360
Do	Texas Pacific Dubai Inc	50.00	United States	2,020
	Union Texas Dubai Inc	25.00	----do	
	Louisiana Land and Exploration Co	12.50	----do	
	Quintana Dubai Inc	7.50	----do	
	Natomas of Dubai Inc	5.00	----do	
Fujairah:				
Offshore	Reserve Oil and Gas Co	100.00	----do	1,500
Ras al-Khaimah:				
Offshore	Deutsche Schactbau und Tiefbohrgesellschaft m.b.H. (DST) operator	10.00	West Germany	2,330
	Vitol Exploration B.V	25.00	Netherlands	
	Weeks Natural Resources Ltd	25.00	United Kingdom	
	Societa Italiana Resina (SIR)	20.00	Italy	
	Asamera Oil Corp. Ltd	6.00	Canada	
	Canadian Superior Oil Ltd	6.00	----do	
	United Refining Co	6.00	United States	
	Kewanee Oil Co	2.00	----do	
Sharjah:				
Onshore	Pinnacle Gas and Oil/Niklos Drilling	100.00	----do	1,400
Offshore	Crescent Petroleum Co.:			1,500
	Buttes Oil and Gas Co. operator	25.70	----do	
	Ashland Oil Co	25.00	----do	
	Skelley Oil Co	25.00	----do	
	Kerr McGee Corp	12.50	----do	
	Cities Service Co	10.00	----do	
	Juniper Petroleum Corp	1.80	----do	
Do	Houston Oil and Minerals	100.00	----do	500
Do	Reserve Oil and Gas Co	100.00	----do	1,500

See footnote at end of table.

Table 3.—Concessions held in the United Arab Emirates during 1976—Continued

Location	Company	Ownership (percent)	Nationality of company	Area (square kilometers)
Umm al-Quaiwain:				
Onshore	Houston Oil and Minerals	100.00	United States	NA
Offshore	Zapata Exploration Co. operator	7.50	do	1,200
	Canadian Superior Oil Ltd	25.00	Canada	
	Asamera Oil Corp., Ltd	20.00	do	
	United Refining Co	20.00	United States	
	Kewanee Oil Co	10.00	do	
	Gulf Oil Co	10.00	do	
	Andarko Production Co	7.50	do	
Do	Occidental Petroleum Co	100.00	do	NA
Do	United Refining Co	100.00	do	NA

NA Not available.

Table 4.—Abu Dhabi: Exports of crude oil by destination

(Thousand 42-gallon barrels)

Country	1974	1975	1976
Canada	6,314	7,154	2,847
France	112,530	84,972	75,920
Germany, West	33,762	14,564	17,885
Italy	9,964	7,373	14,345
Japan	189,143	106,142	191,479
Netherlands	16,571	72,124	66,576
United Kingdom	44,384	52,268	38,252
United States	44,712	35,588	80,337
Other	61.102	119.426	89,935
Total	518,482	499,611	577,576

Source: Organization of the Petroleum Exporting Countries, Statistics Unit. Annual Statistical Bulletin 1976, Vienna 1977, p. 73.

The Mineral Industry of the United Kingdom

By William F. Keyes [1]

Although 1976 saw a recovery from the previous year's recession, the British economy remained sluggish. Gross national product, which was about $196 billion,[2] increased only 1.2% in real terms; however, there was another large deficit in the current account and a substantial depreciation in the pound sterling. Late in 1976, the Chancellor of the Exchequer announced a series of fiscal policies, monetary targets, and measures dealing with employment and investment (including a 1-billion-pound cut in public spending), increases in excise taxes, and limits on credit expansion. This was the second round of such measures in the same year.

Although there was an increase of 10% in steel production, the industry was still working below capacity. A new tin mine started operating in Cornwall, and interest in several tungsten prospects was intense. The potash mine continued to strive to meet production goals, and chances of a second potash mine opening were improved by a change of ownership of a leading prospect.

The extractive industries in the United Kingdom consisted largely of fuel producers in 1976. Natural gas from the North Sea supplied all the country's needs, and petroleum production, also from the North Sea, was increasing rapidly; these North Sea sources should make the United Kingdom self-sufficient in energy in the 1980's. Coal was the only solid mineral mined in large tonnages in 1976, although moderate amounts of other metalliferous and nonmetallic ores were also produced, as were sufficient amounts of the ubiquitous construction materials.

As of March 1976, aid amounting to 1.46 million pounds had been granted by the Department of Industry under the Mineral Exploration and Investment Grants Act for 1972; however, the amount actually disbursed by 1977 was only about 740,000 pounds. Thirty-two companies with 126 projects had been granted assistance; 12 of these grants were made in the fiscal year ending March 31, 1976, including 5 for fluorspar, 1 for barite, and 6 for nonferrous metals.

The Government did not take action in 1976 to implement the Stevens Report, which had been completed the previous year (see 1975 Minerals Yearbook), and which recommended improvements in Government control of mining operations.

PRODUCTION

Coal production declined, but overall hydrocarbon production continued upward; consequently, from 1975 to 1976, the index of mining and quarrying production increased about 4%, from 86.0 to 89.2 (1970=100). The index of metal production increased over 8%, from 78.6 to 85.3; the increase stemmed mainly from a 10% increase in steel production.

[1] Supervisory physical scientist, International Data and Analysis.

[2] The average exchange rate in 1976 of the United Kingdom pound (UK£) in relation to the U.S. dollar was UK£1.00=US$1.80.

Coal production should increase as the effects of an ongoing modernization plan become visible. The start of the approaching great buildup in North Sea oil production was clearly seen, as output soared to almost 10 times that of 1975. Natural gas production increased 9%.

The major mineral and metal producers in the United Kingdom in 1976 are listed in the following tabulation:

Commodity	Major companies, principal facilities, and ownership	Percent of domestic output
Aluminum	British Aluminium Co. Ltd., smelters at Invergordon, Fort William, and Kinlochleven	39
Do	Alcan (U.K.) Ltd., smelter at Lynemouth, Alcan (Canada)	33
Do	Anglesey Aluminium Ltd., smelter at Holyhead, Kaiser Aluminum & Chemical Corp. and Rio Tinto-Zinc Corp. Ltd. (RTZ)	28
Cement	Associated Portland Cement Co. Manufacturers Ltd., plants at Northfleet, Hope and Dunbar	70
Do	Rugby Portland Cement Co. Ltd., plants at Rugby, Barrington, and Southampton	12
Do	Tunnel Holdings Ltd., plants at West Thurrock, Pitstone, and Padeswood	11
Coal	National Coal Board (NCB), mines in south Scotland, Durham, Midlands, and south Wales, Government	100
Copper	British Copper Refiners Ltd., refinery at Liverpool	50
Do	IMI Refiners Ltd., refinery at Birmingham	20
Ferroalloys	British Steel Corporation (BSC), plant at Workington, Cumberland, Government	80
Fluorspar	Laporte Industries Ltd., mines near Eyam, Derbyshire	60
Iron ore	BSC, mines in Lincolnshire and Northamptonshire, Government	100
Lead	Britannia Lead Co. Ltd., refinery at Gravesend, Mt. Isa, Australia	70
Natural gas	British Petroleum Ltd. (BP), Shell U.K. Ltd., Esso U.K. Ltd., Amoco (UK) Ltd., Phillips Petroleum U.K. Ltd., and Gulf Oil (Great Britain) Ltd., in North Sea fields	100
Nickel	Inco Europe Ltd., plant at Clydach, Wales, Inco Ltd. (Canada)	100
Petroleum, crude	BP, Forties Field, North Sea	60
Do	Hamilton Brothers Oil and Gas Ltd., RTZ, and Texaco Ltd., Argyll Field, North Sea	40
Petroleum, refined	BP, Isle of Grain, Grangemouth, Llandarey, and Belfast	21
Do	Esso Petroleum Co. Ltd., Fawley, Milford Haven	22
Do	Shell, Stanlow, Shellhaven, and Teesport	24
Potash	Cleveland Potash Ltd., mine at Boulby, ICI Ltd., Charter Consolidated (North Sea Explorations) Ltd	100
Steel	BSC, mills at south Wales, Scunthorpe, south Teesside, and Motherwell, Government	90
Tin ore	Geevor Tin Mines Ltd., mine at Geevor	25
Do	St. Piran Ltd., mine at South Crofty	35
Do	Wheal Jane Ltd., mine at Truro, Consolidated Gold Fields Limited	38
Do	Cornwall Tin and Mining Ltd., Mt. Wellington mine at Truro, Excomm (United States), start 1976	--
Zinc	Commonwealth Smelting Ltd., smelter at Avonmouth, RTZ	100

Table 1.—United Kingdom: Production of mineral commodities

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Aluminum:			
Alumina	r 97	83	96
Metal:			
Primary	294	308	335
Secondary	207	176	206
Antimony, primary smelter [1] ——tons	e 7,800	NA	NA
Cadmium metal including secondary ——do	280	262	190
Copper:			
Ore and concentrate, metal content ——do	434	457	600
Refined:			
Primary ——do	69,096	75,500	51,600
Secondary ——do	91,027	76,000	85,700
Iron and steel:			
Iron ore	3,602	4,490	4,582
Pig iron	13,811	12,046	13,713
Ferroalloys, blast furnace:			
Ferromanganese	83	85	122
Spiegeleisen	8	(2)	--
Total	91	85	122
Steel:			
Crude	22,426	20,198	22,274
Semimanufactures:			
Sections	5,658	4,765	5,238
Wire rods	1,549	1,415	1,538
Plates and sheets	7,967	6,217	7,144
Strip	1,121	1,031	1,264
Pipe, tube, stock	739	828	711
Railway track material	285	344	226
Other rolled [3]	1,027	973	978
Castings and forgings	398	391	360
Total	18,744	15,964	17,459
Lead:			
Mine output, metal content ——tons	3,600	6,396	7,100
Metal:			
Bullion, from imported ores and concentrates ——do	29,380	25,700	16,500
Refined:			
Primary [4] ——do	136,994	105,100	132,200
Secondary [5] ——do	139,916	123,400	119,300
Total ——do	276,910	228,500	251,500
Magnesium metal including secondary ——do	3,800	2,800	3,000
Nickel metal, refined, including ferronickel ——do	33,698	37,300	33,100
Silver metal ——thousand troy ounces	--	140	108
Tin:			
Mine output, metal content ——tons	3,827	3,330	4,000
Metal:			
Primary ——do	11,818	11,500	9,850
Secondary ——do	3,561	5,600	2,800
Tungsten, mine output, metal content ——do	10	10	e 10
Zinc:			
Ore and concentrate, metal content ——do	3,008	4,001	4,800
Smelter ——do	84,351	53,400	41,600
NONMETALS			
Barite and witherite	50	51	50
Bromine ——tons	27,200	28,300	29,900
Calcite	21	19	16
Cement, hydraulic	17,781	16,891	15,780
Chalk	20,415	17,890	15,941
Clays:			
Fire clay	2,277	1,535	1,513
Fuller's earth	166	164	201
Kaolin (china clay)	4,290	3,220	3,847
Pottery and ball clay	8	12	14
Other including clay shale	30,337	26,748	26,028
Diatomite ——tons	4,000	3,500	e 3,500
Feldspar (china stone) e ——do	50,000	50,000	50,000
Fertilizers, manufactured: [6]			
Nitrogenous (N content)	755	840	821
Phosphatic (P_2O_5 content)	438	412	394
Other, gross weight	2,837	2,595	2,867

See footnotes at end of table.

Table 1.—United Kingdom: Production of mineral commodities—Continued

(Thousand metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
NONMETALS—Continued			
Fluorspar:			
Acid grade	124	127	134
Metallurgical grade	36	33	54
Ungraded	15	19	29
Total	175	179	217
Gypsum, plaster, anhydrite	4,901	r 3,479	r 3,350
Mica	--	--	1
Refractory products: [8]			
Bricks	941	824	809
Cement	47	62	64
Other	131	417	457
Salt:			
Rock	990	754	611
Brine	1,862	1,740	1,918
Other	5,569	5,136	5,477
Stone, sand and gravel:			
Stone:			
Chert and flint	160	NA	322
Igneous rock	41,717	42,827	37,215
Limestone and dolomite	100,915	101,175	89,364
Sandstone, including ganister	14,380	12,598	13,522
Slate	64	58	295
Sand and gravel:			
Common sand and gravel	120,300	134,085	117,800
Special sands	4,612	6,041	5,677
Strontium minerals tons	2,400	1,900	5,400
Sulfur:			
Elemental	65	58	77
Sulfuric acid	3,855	3,166	3,271
Talc, soapstone, pyrophyllite tons	20,600	19,100	14,800
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	201	209	214
Coal:			
Anthracite	2,534	2,534	2,363
Bituminous	106,684	125,286	119,845
Other	1,000	858	1,592
Coke:			
Metallurgical	15,776	15,859	15,754
Gashouse	16	([2])	--
Breeze, all types	1,052	1,187	1,164
Fuel briquets, all grades	992	1,190	NA
Gas:			
Manufactured [9] million therms	526	211	NA
Natural million cubic feet	1,230,039	1,208,180	1,316,358
Natural gas liquids thousand 42-gallon barrels	3,059	3,240	5,721
Petroleum:			
Crude do	637	8,902	84,655
Refinery products:			
Gasoline:			
Aviation do	2,473	2,311	2,127
Motor do	123,473	118,541	129,472
Jet fuel do	33,905	28,809	52,173
Kerosine do	21,548	20,446	
Distillate fuel oil do	206,205	174,000	180,517
Residual fuel oil do	266,669	217,953	217,749
Lubricants do	10,185	7,985	9,100
Other do	103,125	74,944	82,987
Refinery fuel and losses do	52,269	44,843	52,500
Total do	819,852	689,832	726,625

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Includes antimony content of antimonial lead and antimony compounds.

[2] Less than ½ unit.

[3] Includes wheels, centers, tires, and axles, and semimanufactures for sale.

[4] Lead refined from imported bullion.

[5] Lead refined from scrap materials and domestic ores.

[6] Year ending May 31 of that stated.

[7] Excludes plaster.

[8] Consists of bricks, retorts, molds, and other refractory products made from clays, silica, siliceous material, magnesite, alumina, and chrome materials.

[9] Gas made at gasworks plus purchased coke-oven refinery gas.

TRADE

The value of United Kingdom trade increased 29% in 1976, to total values of 31.1 billion pounds for imports and 25 billion pounds for exports. Crude minerals and ores represented 878 million pounds (2.8%) of the imports and 260 million pounds (1.0%) of the exports; crude and refined petroleum represented another 5.5 billion pounds (18%) of the imports and 1.2 billion pounds (5%) of exports. The role of the United Kingdom as a minerals processor and consumer was underlined by imports of metals and metal manufactures valued at 3.8 billion pounds (12%) and exports valued at 2.3 billion pounds (9%).

U.S. exports to the United Kingdom were mainly in the form of metal scrap for smelting and refining, coal and coke, and iron and steel products; total U.S. exports of minerals and metals to the United Kingdom were valued at $460 million in 1976. U.S. imports from the United Kingdom included crude and refined petroleum, radioactive elements, diamonds, and metal manufactures, for a total value of $760 million in 1976.

Table 2.—United Kingdom: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite and concentrate	248	396	NA.
Oxide and hydroxide	110,572	24,669	Spain 3,405; Ireland 2,769; Portugal 2,058.
Metal including alloys:			
Scrap	13,033	16,720	West Germany 8,811; Netherlands 2,922.
Unwrought	86,901	87,695	People's Republic of China 23,163; Netherlands 16,904; West Germany 8,950.
Semimanufactures	86,270	54,313	Nigeria 4,939; Ireland 4,167; France 3,661.
Antimony metal	r1 1,100	NA	
Arsenic trioxide, pentoxide, acid	2,471	2,608	New Zealand 1,593.
Beryllium metal including alloys, all forms	1	6	NA.
Bismuth metal including alloys	r1 466	NA	
Cadmium metal including alloys	r 193	NA	
Chromium:			
Chromite	4,450	2,851	NA.
Oxide and hydroxide value, thousands	r $1,251	$2,029	NA.
Metal including alloys, all forms	r1 4,406	NA	
Cobalt:			
Oxide and hydroxide	158	149	Spain 16.
Metal including matte, speiss, etc	r1 300	NA	
Columbium and tantalum metal including alloys, all forms, tantalum	33	63	United States 27.
Copper:			
Ore and concentrate	r 677	161	West Germany 131.
Metal including alloys:			
Scrap	29,954	35,323	West Germany 15,312.
Unwrought	72,081	43,754	West Germany 11,235; Italy 8,282.
Semimanufactures	115,835	122,578	Switzerland 20,939; Ireland 8,393.
Gold, unworked or partly worked:			
Bullion, refined thousand troy ounces	r1 21,808	NA	
Other do	r 1,154	NA	
Iron and steel:			
Ore and concentrate, except roasted pyrite	375	249	NA.
Metal:			
Scrap thousand tons	312	916	NA.
Pig iron, ferroalloys, similar materials do	325	61	West Germany 9; Sweden 6; Netherlands 4.
Steel, primary forms do	224	256	United States 77; Italy 36; West Germany 30; Spain 27.

See footnotes at end of table.

Table 2.—United Kingdom: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures:			
Bars, rods, angles, shapes, sections:			
Wire rod, thousand tons	176	160	West Germany 23; Belgium-Luxembourg 16; United States 16.
Other bars and rods, do	453	530	West Germany 48; Trucial States 36; Sweden 28.
Angles, shapes, sections, do	r 537	542	United States 119; U.S.S.R. 77; Canada 34.
Universals, plates, sheets:			
Universals and heavy plates, uncoated, do	252	181	Canada 25; Netherlands 20; United States 20.
Medium plates and sheets, uncoated, do	30	10	Ireland 3; United States 1.
Light plates and sheets, uncoated, do	404	298	United States 74; Sweden 29; U.S.S.R. 25.
Tinned plates and sheets, do	216	206	Argentina 22; India 21; Brazil 15.
Other coated plates and sheets, do	221	147	Norway 16; France 13; West Germany 11.
Hoop and strip, do	138	99	Ireland 7; United States 7; France 5.
Rails and accessories, do	190	136	France 21; New Zealand 19; Italy 8.
Wire, do	216	111	United States 23; Canada 18.
Tubes, pipes, fittings, do	767	562	Sweden 54; Netherlands 44; Ireland 27.
Castings and forgings, rough, do	62	70	United States 24; Sweden 17.
Total, do	r 3,662	3,052	
Lead:			
Ore and concentrate	5,871	10,414	Belgium-Luxembourg 8,808.
Oxides	9,109	8,265	Ireland 2,741; Sweden 1,340; Egypt 797.
Metal including alloys:			
Scrap	24,892	19,069	Italy 6,075; West Germany 3,835; Netherlands 3,230.
Unwrought	138,779	106,606	West Germany 27,705; Netherlands 22,519; France 9,657.
Semimanufactures	2,641	3,203	NA.
Magnesium metal including alloys:			
Scrap	94	303	NA.
Unwrought	10,829	1,166	Canada 323; France 252.
Semimanufactures	418	530	NA.
Manganese:			
Ore and concentrate	138,302	3,803	NA.
Oxides	2,010	4,079	Austria 800.
Mercury, 76-pound flasks	4,119	1,479	NA.
Molybdenum metal including alloys, all forms	138	128	Netherlands 16.
Nickel:			
Matte, speiss, similar materials	1,558	774	Italy 275; Spain 160.
Metal including alloys:			
Scrap	4,237	4,042	West Germany 1,366; Netherlands 1,079.
Unwrought	40,104	31,484	West Germany 9,205; France 5,756; Sweden 4,847.
Semimanufactures	26,689	10,385	France 1,547; West Germany 1,063; United States 942.
Platinum-group metals and silver:			
Ore and concentrate, value, thousands	r $442	$9	NA.
Waste and sweepings, do	r $8,521	$4,957	West Germany $1,270; Belgium-Luxembourg $1,024.
Metals including alloys:			
Platinum group, thousand troy ounces	868	1,029	United States 354; West Germany 193.

See footnotes at end of table.

Table 2.—United Kingdom: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Platinum-group metals and silver—Continued			
Metals including alloys—Continued			
Silver:			
Refined thousand troy ounces	r 68,674	50,605	Switzerland 18,808; France 6,141; West Germany 5,080.
Other ---do---	r 418	1,254	Sweden 932.
Tin:			
Ore and concentrate	1,944	2,819	Malaysia 2,362; Netherlands 108.
Oxides	462	745	United States 94; Spain 37.
Metal including alloys:			
Scrap	628	68	Netherlands 38.
Unwrought	58,114	14,574	Norway 5,555; Netherlands 3,959.
Semimanufactures	1,006	1,013	Norway 166; France 133.
Titanium oxides	r 6,130	6,246	Ireland 762; West Germany 651; Japan 609.
Tungsten:			
Ore and concentrate	1,038	189	West Germany 69; Netherlands 60.
Metal including alloys, all forms	387	687	West Germany 198; Netherlands 103.
Uranium and thorium:			
Ore and concentrate	200	--	
Metal including alloys, all forms kilograms	r 13,000	6,000	NA.
Zinc:			
Ore and concentrate	14,009	25,280	Sweden 10,870.
Oxide and peroxide	15,301	7,808	Belgium-Luxembourg 1,325; West Germany 844; Netherlands 653.
Metal including alloys:			
Scrap	4,634	5,240	France 1,363.
Blue powder	153	42	NA.
Unwrought	12,686	17,877	United States 8,989; Denmark 1,808; Ireland 1,535.
Semimanufactures	10,451	4,240	Ireland 742; Netherlands 372.
Other:			
Ores and concentrates:			
Of molybdenum, tantalum, titanium, vanadium, zirconium value, thousands	r $2,992	$7,812	Belgium-Luxembourg $2,404; Japan $484.
Of base metals, n.e.s ---do---	r $358	$204	NA.
Ash and residue containing nonferrous metals	72,772	49,184	West Germany 19,735; Belgium-Luxembourg 9,631; Canada 9,234.
Oxides, hydroxides, peroxides of metals, n.e.s	44,642	99,754	Netherlands 27,190; Spain 21,105; France 18,289.
Metals including alloys, all forms:			
Metalloids, n.e.s value, thousands	r $6,191	$2,631	Republic of South Africa $238; United States $218.
Alkali, alkaline-earth, rare-earth metals	194	171	NA.
Pyrophoric alloys	r 651	567	NA.
Base metals including alloys, all forms, n.e.s	9,629	7,326	United States 2,315; West Germany 929; France 715.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	6,526	5,584	NA.
Dust and powder of precious and semiprecious stones value, thousands	r $9,071	$8,536	Netherlands $2,062; United States $1,044; Japan $1,040.
Grinding and polishing wheels and stones	9,182	8,010	Sweden 1,111; Italy 823; West Germany 769.
Asbestos, crude and waste	4,698	1,698	France 236.
Barite and witherite	4,848	3,993	NA.
Boric oxide and acid	145	256	NA.

See footnotes at end of table.

Table 2.—United Kingdom: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Cement	r 1,060,410	1,121,045	United States 173,675; Ivory Coast 168,220; Spain 117,638.
Chalk	58,843	35,976	NA.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s ---thousand tons--	3,043	2,190	West Germany 338; Italy 308; Finland 224; France 223.
Products:			
Refractory (including nonclay bricks) ---do---	430	341	Italy 46; Sweden 44; Netherlands 18.
Nonrefractory ---do---	90	89	Australia 11; Canada 10; United States 7.
Cryolite and chiolite	10	--	
Diamond, all grades ---value, millions--	r $1,834	$1,863	Switzerland $664; Belgium-Luxembourg $506; Israel $247.
Diatomite and other infusorial earth value, thousands--	$306	$264	NA.
Feldspar and fluorspar	90,793	51,275	Norway 19,190; Netherlands 17,462.
Fertilizer materials:			
Crude:			
Nitrogenous	379	340	NA.
Phosphatic	429	141	NA.
Potassic	24	11	NA.
Manufactured:			
Nitrogenous	130,788	153,794	Netherlands 30,051; Egypt 18,508; Ireland 13,955.
Phosphatic	91,204	59,233	Ireland 20,539; Netherlands 7,500.
Potassic	9,826	4,428	NA.
Other including mixed	529,494	406,254	Ireland 121,787; Belgium-Luxembourg 71,001; Netherlands 49,063.
Graphite, natural	21,804	2,795	NA.
Gypsum and plasters	14,924	24,221	NA.
Lime	42,063	37,210	Nigeria 9,002; Ghana 1,958.
Magnesite	7,063	48,385	NA.
Mica:			
Crude including splittings and waste	2,096	1,603	NA.
Worked including agglomerated splittings	250	156	NA.
Pigments, mineral:			
Natural, crude	3,921	3,681	NA.
Iron oxides, processed	9,479	8,199	United States 637.
Precious and semiprecious stones, except diamond:			
Natural ---value, thousands--	r $46,436	$49,086	Switzerland $20,103; West Germany $5,572.
Manufactured ---do---	r $353	$178	NA.
Salt ---thousand tons--	624	519	Sweden 177; Nigeria 135; Ireland 50.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	222,472	250,740	Australia 166,825; Iran 20,719.
Caustic potash, sodic and potassic peroxides	1,316	310	Ireland 205.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	32,311	6,221	West Germany 1,034.
Worked	6,874	11,976	NA.
Dolomite, chiefly refractory grade	12,447	12,086	Chile 4,728.
Gravel and crushed rock thousand tons--	4,788	4,105	Netherlands 1,576; France 1,290; Belgium-Luxembourg 903.
Limestone (except dimension)	85,232	9,500	NA.
Quartz and quartzite	2,724	110	NA.
Sand, excluding metal bearing	120,427	69,841	Ireland 25,059; West Germany 3,759.
Strontium minerals, celestite	1 2,100	NA	
Sulfur:			
Elemental:			
Other than collodial	6,023	1,941	NA.
Colloidal	458	75	NA.

See footnotes at end of table.

Table 2.—United Kingdom: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Sulfur—Continued			
Sulfur dioxide ----------value--	r $51,460	--	
Sulfuric acid ----------	200,597	165,831	Morocco 45,458; Turkey 31,080; Ireland 24,782.
Talc, steatite, soapstone, pyrophyllite ---	1,790	1,642	NA.
Other nonmetals, n.e.s.:			
Crude ----------	r 601,019	820,736	Norway 239,204; Belgium-Luxembourg 173,600; West Germany 119,078.
Slag, dross, and similar waste, not metal bearing:			
From iron and steel manufacture	76,540	138,441	NA.
Slag and ash, n.e.s ----------	4,378	2,470	NA.
Oxides and hydroxides of magnesium, strontium, barium ----------	63,754	30,531	West Germany 6,280; France 4,528; Spain 3,555.
Halogens, other than chlorine ------	2,100	1,840	Switzerland 689; West Germany 380; Netherlands 239.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s ----------	93,429	74,342	Ireland 10,619; France 2,218.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural ----------	3,181	1,379	NA.
Carbon black ----------	49,412	32,200	Ireland 5,490; Nigeria 3,738; France 2,497.
Coal and briquets:			
Anthracite and bituminous coal thousand tons--	r 1,865	2,182	France 735; Belgium-Luxembourg 420; West Germany 392.
Briquets of anthracite and bituminous coal ----------do----	264	284	Norway 229; West Germany 28.
Lignite and lignite briquets --------	24	80	NA.
Coke and semicoke------thousand tons--	1,704	1,315	Sweden 378; Norway 221; Netherlands 146.
Hydrogen and rare gases ----------	1,276	1,072	NA.
Peat including peat briquets and litter --	1,821	1,786	NA.
Petroleum:			
Crude and partly refined:			
Crude thousand 42-gallon barrels--	r 6,761	5,659	Ireland 3,545; West Germany 998.
Partly refined ----------do----	r 665	1,965	Netherlands 1,923.
Refinery products:			
Gasoline (including natural) do----	r 22,407	21,225	Ireland 5,326; Sweden 5,113; Netherlands 4,945.
Kerosine and jet fuel-----do----	r 5,628	6,262	Ireland 1,799; Norway 1,047; Denmark 927.
Distillate fuel oil --------do----	r 52,242	42,875	Netherlands 11,064; Sweden 10,703; Denmark 6,910.
Residual fuel oil --------do----	r 23,984	25,783	Ireland 7,226; Denmark 5,493; Netherlands 3,440.
Lubricants ----------do----	r 5,922	4,711	Algeria 521; Sweden 397; West Germany 272.
Other:			
Liquefied petroleum gas do----	r 2,310	2,109	Ireland 691; Portugal 393; Denmark 213.
Mineral jelly and wax-do----	220	143	Netherlands 28; Ireland 11.
Nonlubricating oils, n.e.s do----	r 589	268	Republic of South Africa 51; Australia 33.
Bitumen and other residues and bituminous mixtures, n.e.s ----------do----	r 1,004	1,095	Ireland 677.
Pitch, pitch coke, petroleum coke ----------do----	r 653	1,755	Norway 330; Canada 86.
Total ----------do----	r 114,959	106,226	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals -------	206,062	187,968	Netherlands 57,576; Norway 19,322.

r Revised. NA Not available.

[1] Institute of Geological Sciences. United Kingdom Mineral Statistics, 1975. London. 1975, 161 pp.

Table 3.—United Kingdom: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate thousand tons	324	296	Ghana 224; Greece 40.
Oxide and hydroxide do	603	558	Jamaica 449; Guyana 69.
Metal including alloys:			
Scrap do	22	14	NA.
Unwrought do	281	160	Norway 81; Iceland 17.
Semimanufactures do	132	79	NA.
Arsenic trioxide, pentoxide, acids	5,934	5,120	NA.
Beryllium metal including alloys, all forms	(1)	8	NA.
Bismuth metal including alloys, all forms	r 2 501	NA	
Cadmium metal including alloys, all forms	r 2 1,336	NA	
Chromium:			
Chromite thousand tons	151	144	Republic of South Africa 81; Philippines 53.
Oxide and hydroxide value, thousands	$508	$191	NA.
Cobalt:			
Oxide and hydroxide	1,065	884	Canada 790.
Metal including alloys, all forms	r 2 2,807	NA	
Columbium and tantalum, tantalum metal including alloys, all forms	53	27	United States 20; Belgium-Luxembourg 3.
Copper:			
Ore and concentrate	46	301	NA.
Matte	1,570	--	NA.
Metal including alloys:			
Scrap	26,132	10,237	United States 2,030; Ireland 1,567; West Germany 1,317.
Unwrought	458,658	451,858	Zambia 136,166; Chile 101,480; Canada 87,773.
Semimanufactures	44,120	23,895	West Germany 5,843; Finland 3,612.
Gold, worked or partly worked: Bullion:			
Refined thousand troy ounces	17,289	15,407	NA.
Unrefined do	311	311	NA.
Other do	2	1	NA.
Iron and steel:			
Ore and concentrate, except roasted pyrite thousand tons	19,675	15,783	Canada 3,061; Sweden 2,242; Venezuela 1,803.
Roasted pyrite do	617	304	Sweden 283.
Metal:			
Scrap do	140	88	United States 64; Netherlands 13.
Pig iron including cast iron, sponge, powder, and shot do	143	87	Canada 28; Norway 28.
Ferroalloys:			
Ferromanganese do	124	96	Norway 54; Republic of South Africa 32.
Other do	198	230	NA.
Steel, primary forms do	447	622	West Germany 130; Netherlands 114; Belgium-Luxembourg 99.
Semimanufactures:			
Bars, rods, angles, shapes, sections:			
Wire rods do	114	141	Italy 15; Netherlands 15.
Other bars and rods do	450	277	Sweden 64; West Germany 47; Spain 45.
Angles, shapes, sections do	364	99	Belgium-Luxembourg 19; Sweden 16; Ireland 14.
Universals, plates, sheets:			
Heavy and medium plates and sheets, uncoated do	r 1,534	689	West Germany 208; Belgium-Luxembourg 142; Japan 90.
Light plates and sheets, uncoated do	r 975	853	Netherlands 277; West Germany 182; Belgium-Luxembourg 176.

See footnotes at end of table.

Table 3.—United Kingdom: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures—Continued			
Universals, plates, sheets—Continued			
Tinned plates and sheets thousand tons	481	57	Netherlands 42.
Other coated plates and sheets ---do---	145	145	West Germany 46; Belgium-Luxembourg 38.
Hoop and strip ---do---	173	106	Belgium-Luxembourg 51; West Germany 38.
Rails and accessories---do---	1	1	NA.
Wire ---do---	31	22	NA.
Tube, pipes, fittings---do---	772	753	Netherland 152.
Castings and forgings, rough ---do---	17	20	West Germany 4; Portugal 3.
Total ---do---	r 5,057	3,163	
Lead:			
Ore and concentrate ---do---	55	47	Peru 13.
Oxides	550	114	NA.
Metal including alloys:			
Scrap	3,709	1,597	NA.
Unwrought ---thousand tons---	217	202	Australia 154; Canada 42.
Semimanufactures	1,291	1,202	Ireland 857; Netherlands 244.
Magnesium metal including alloys:			
Scrap	934	381	West Germany 218; Netherlands 80.
Unwrought	7,988	4,405	Norway 1,811; Canada 1,340; United States 457.
Semimanufactures	163	253	NA.
Manganese:			
Ore and concentrate---thousand tons---	388	253	Brazil 79; Republic of South Africa 65; Gabon 59.
Oxides	5,635	2,746	Japan 2,472.
Metal	r 2 4,400	NA	
Mercury ---76-pound flasks---	24,076	21,350	Netherlands 8,006; Spain 4,380.
Molybdenum:			
Ore and concentrate	r 10,634	NA	
Metal including alloys, all forms	189	170	Austria 77; United States 56.
Nickel:			
Matte, speiss, similar materials	49,870	66,876	Canada 64,955.
Metal including alloys:			
Scrap	6,861	2,705	United States 951; West Germany 411; France 303.
Unwrought	24,858	23,931	Canada 17,507; Australia 1,921.
Semimanufactures	6,659	5,701	Canada 1,913; United States 1,763.
Platinum-group metals and silver:			
Ores and concentrates value, thousands	r $145,804	$123,754	NA.
Waste and sweepings ---do---	r $163,564	$52,917	United States $21,514; India $7,907.
Metals including alloys:			
Platinum group thousand troy ounces	96	193	Republic of South Africa 64.
Silver ---do---	r 48,766	81,920	India 28,614; United States 20,448; France 7,491.
Selenium, elemental	r 2 216	NA	
Silicon, elemental	r 2 20,695	NA	
Tin:			
Ore and concentrate	r 39,752	42,910	Bolivia 31,493; Republic of South Africa 2,961.
Oxides	10	(1)	NA.
Metal including alloys:			
Scrap	1,692	1,303	United States 395; West Germany 174; Poland 155.
Unwrought and semimanufactures	8,036	6,293	Nigeria 2,719; Australia 1,244; Netherlands 868.
Titanium:			
Ore and concentrate	r 2 390,100	NA	
Oxides	4,159	2,145	West Germany 601; Belgium-Luxembourg 546; France 161.
Metal including alloys, all forms	r 2 5,000	NA	

See footnotes at end of table.

Table 3.—United Kingdom: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Tungsten:			
Ore and concentrate	4,009	3,355	Portugal 717; Netherlands 511; Thailand 258.
Metal including alloys, all forms	119	221	West Germany 91; United States 57.
Uranium and thorium:			
Ore and concentrate	752	913	NA.
Metal including alloys, all forms	9	4	NA.
Zinc:			
Ore and concentrate—thousand tons	206	108	Peru 58; Australia 15; Ireland 8.
Oxide and peroxide	3,534	1,147	France 303; West Germany 193.
Metal including alloys:			
Scrap and blue powder	3,263	1,914	NA.
Unwrought—thousand tons	206	200	Canada 60; Netherlands 43; Finland 26.
Semimanufactures	4,177	4,333	West Germany 1,968.
Zirconium: [2]			
Ore and concentrate	r 36,200	NA	
Metal including alloys, all forms	r 1,000	NA	
Other:			
Ash and residue containing nonferrous metals	76,001	68,908	Canada 18,742; United States 12,626; West Germany 8,715.
Oxides, hydroxides, peroxides of metals, n.e.s	288,950	258,967	Netherlands 89,555; Trinidad and Tobago 55,251; West Germany 18,455.
Metals including alloys, all forms:			
Metalloids, n.e.s—value, thousands	r $69,459	$54,576	NA.
Alkali, alkaline earth, rare-earth metals	1,091	993	West Germany 486; France 398.
Pyrophoric alloys	r 23	19	NA.
Base metals including alloys, all forms, n.e.s	14,770	11,916	Republic of South Africa 3,980; United States 1,968.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc—thousand tons	106	138	Italy 72; Turkey 15.
Dust and powder of precious and semiprecious stones—value, thousands	r $11,099	$11,560	NA.
Grinding and polishing wheels and stones	2,665	2,585	Netherlands 517; Italy 401; West Germany 351.
Asbestos—thousand tons	153	139	Canada 70; Republic of South Africa 29; Swaziland 22.
Barite and witherite—do	54	28	Morocco 7.
Boron materials:			
Borax	r 2 18,700	NA	
Oxide and acid	8,000	4,034	France 2,451; United States 784.
Bromine	r 1,300	NA	
Cement—thousand tons	201	104	Ireland 88; West Germany 6.
Chalk	1,069	585	NA.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s—thousand tons	174	166	United States 76; Republic of South Africa 44.
Products:			
Refractory (including nonclay brick)	73,066	78,487	Austria 15,129; Ireland 13,652; West Germany 12,286.
Nonrefractory	36,541	28,337	Italy 7,598; West Germany 5,815; Spain 2,354.
Cryolite and chiolite	1,960	2,520	Denmark 2,500.
Diamond, all grades—value, millions	r $1,828	$1,948	NA.
Diatomite and other infusorial earth—value, thousands	$2,283	$2,248	United States $1,133; Denmark $400; France $302.
Feldspar and fluorspar—thousand tons	197	171	Norway 113; Finland 36.

See footnotes at end of table.

Table 3.—United Kingdom: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Fertilizer materials:			
Crude:			
Nitrogenous ---thousand tons--	10	7	Chile 4; Netherlands 2.
Phosphatic ---do---	2,042	1,588	Morocco 1,146; Senegal 235; United States 141.
Potassic ---do---	26	29	East Germany 16.
Manufactured:			
Nitrogenous ---do---	428	(3)	NA.
Phosphatic:			
Thomas (basic) slag	53,178	33,867	Belgium-Luxembourg 33,801.
Other	21,678	25,722	France 8,583; Netherlands 5,013.
Potassic ---thousand tons--	846	686	West Germany 197; East Germany 162; U.S.S.R. 127.
Other (including mixed) --do---	211	157	Netherlands 75; Belgium-Luxembourg 42; Ireland 19.
Graphite, natural	15,962	14,008	Malagasy Republic 6,640; Norway 2,958.
Gypsum and plasters ---thousand tons--	122	88	Ireland 72; France 14.
Iodine	2,516	2,929	Israel 1,652; Japan 609.
Lime	1,232	1,413	NA.
Magnesite ---thousand tons--	122	138	Spain 40; Greece 33.
Mica:			
Crude including splittings and waste	8,011	10,286	India 1,249.
Worked including agglomerated splittings	514	319	Belgium-Luxembourg 166; West Germany 44.
Pigments, mineral:			
Natural, crude	6,711	4,085	Austria 1,431.
Iron oxides, processed	25,856	17,416	West Germany 13,795.
Precious and semiprecious stones, except diamond:			
Natural ---value, thousands--	r $62,145	$80,467	Switzerland $28,826; West Germany $10,598; France $6,772.
Manufactured ---do---	r $1,179	$1,231	United States $369; Switzerland $302.
Pyrite (gross weight) --thousand tons--	35	28	Norway 2.
Salt and brine ---do---	24	20	NA.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	11,882	47,954	Netherlands 6,547.
Caustic potash, sodic and potassic peroxides	4,194	2,461	West Germany 907; Belgium-Luxembourg 790.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	26,240	13,516	Italy 11,976.
Slate	428	1,431	NA.
Other	19,347	16,063	Republic of South Africa 5,266; Sweden 4,296.
Worked:			
Slate	2,202	2,943	NA.
Paving and flagstone	17,940	14,884	Portugal 13,772.
Other	267,031	16,477	Italy 8,954; India 3,241.
Dolomite	47,735	37,392	Spain 24,206; Norway 11,041.
Gravel and crushed rock thousand tons--	239	431	Ireland 252; Norway 44.
Limestone (except dimension)	5,680	5,851	NA.
Quartz and quartzite	6,708	3,527	NA.
Sand, excluding metal bearing thousand tons--	177	132	Belgium-Luxembourg 119.
Sulfur:			
Elemental:			
Other than colloidal ---do---	1,379	939	Poland 346; France 251; Canada 100.
Colloidal	432	389	NA.
Sulfur dioxide ---value--	$2,339	$2,222	NA.
Sulfuric acid	r 75,924	81,929	NA.
Talc, steatite, soapstone, pyrophyllite ---	61,846	58,480	People's Republic of China 12,396; Norway 12,360; France 11,791.
Other nonmetals, n.e.s.:			
Crude:			
Meerschaum, amber, jet	16,205	20,515	Spain 19,799.
Other ---thousand tons--	377	296	Italy 73; United States 55; Republic of South Africa 48.

See footnotes at end of table.

Table 3.—United Kingdom: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Other nonmetals, n.e.s.—Continued			
Slag, dross and similar waste, not metal bearing:			
From iron and steel manufacture	56,763	97,083	Canada 23,690.
Slag and ash, n.e.s	11,649	38,579	Netherlands 36,378.
Oxides and hydroxides of magnesium, strontium, barium	26,070	31,590	Japan 15,025; Italy 12,730; United States 2,140.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	65,790	47,657	Belgium-Luxembourg 28,744.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	35,223	22,652	Trinidad and Tobago 13,804; France 6,646.
Carbon black and gas carbon:			
Carbon black	9,946	7,128	West Germany 1,634; United States 1,465; France 1,046.
Gas carbon	4	--	
Coal and briquets:			
Anthracite and bituminous thousand tons	3,546	5,083	Australia 2,635; United States 1,794.
Briquets of anthracite and bituminous do	168	119	France 95; West Germany 16.
Lignite and lignite briquets	1,708	18	NA.
Coke and semicoke	3,623	2,718	NA.
Hydrogen and rare gases	r 3,718	2,958	United States 596; Belgium-Luxembourg 526.
Peat including peat briquets and litter thousand tons	126	118	Ireland 107.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r 835,785	651,667	Saudi Arabia 163,375; Iran 127,506; Kuwait 79,123.
Refinery products:			
Gasoline (including natural) do	r 53,040	47,527	Netherlands 11,398; Belgium-Luxembourg 6,222; Italy 6,030.
Kerosine and jet fuel do	r 8,584	9,830	Netherlands 5,661; Belgium-Luxembourg 904.
Distillate fuel oil do	r 10,229	17,665	Netherlands 6,130; U.S.S.R. 2,032; France 1,786.
Residual fuel oil do	r 40,120	30,119	Netherlands 11,805; Belgium-Luxembourg 3,981; Ireland 2,562.
Lubricants do	r 3,907	2,682	Netherlands Antilles 553; France 528; Netherlands 509.
Other:			
Liquefied petroleum gas do	8,271	9,505	Algeria 7,494; Sweden 857.
Mineral jelly and wax do	r 655	406	Netherlands 359.
Nonlubricating oils, n.e.s do	201	132	United States 47; West Germany 43; Belgium-Luxembourg 21.
Bitumen and other residues and bituminous mixtures, n.e.s do	r 1,815	1,311	United States 710; Netherlands 329.
Pitch, pitch coke, petroleum coke do	1,082	1,390	United States 758; Belgium-Luxembourg 241.
Total do	r 127,904	120,567	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	250,493	225,632	Netherlands 89,880; Sweden 27,667.

r Revised. NA Not available.
[1] Less than ½ unit.
[2] Institute of Geological Sciences. United Kingdom Mineral Statistics, 1975. London. 1975, 161 pp.
[3] Value only reported at $24,342,000.

COMMODITY REVIEW

METALS

Aluminum.—Production increased in 1976, in spite of a loss of about 8,000 tons caused late in the year by a fire at the Invergordon plant of British Aluminium Co. Ltd. The Lynemouth smelter of Alcan (U.K.) Ltd. operated near full capacity during the year, and Invergordon did as well until the fire; even the troubled Anglesey smelter, now owned by Kaiser Aluminum & Chemical Corp. and Rio Tinto-Zinc Corp. Ltd. (RTZ), was operating near capacity.

Two additional small plants, at Kinlochleven and Fort William, Scotland, were operated by British Aluminium. Total industry capacity was about 360,000 tons of aluminum ingot per year.

Copper.—Planning permission was granted to Messina (Transvaal) Development Co. Ltd. of the Republic of South Africa to drill 15 exploratory boreholes in the Shetland Islands. Opencast mining was carried out on the islands until 200 years ago, and preliminary boreholes by the Department of Industry indicated mineralization to a depth of 100 meters along a strike length of 500 meters.

A contract was awarded by BICC Metals Ltd., operators of the refinery at Prescot, for expansion of anode-casting facilities and construction of a new tankhouse, increasing total capacity to 55,000 tons of electrolytic copper per year. Remaining domestic copper-refining capacity was at Widnes, operated by the same company, and at the plant of IMI Refiners Ltd. at Birmingham.

The only copper mined in the United Kingdom was a minor amount recovered as a byproduct of tin mining in Cornwall.

Iron and Steel.—A record loss of 255 million pounds (about $450 million) was registered by the nationalized British Steel Corp. (BSC) in the 1975–76 financial year, and this was followed by a further loss of 95 million pounds ($165 million) in 1976–77. By yearend 1976, the British industry had followed the world industry into a severe recession. BSC, producer of about 90% of the national total, needed to operate at or near full capacity (about 25 million tons per year) to make a profit; but, although production increased about 10% over that of 1975, market conditions made that impossible. The losses also reflected falling export prices owing to the depressed value of the pound sterling and severe import competition. Basic to the entire problem was BSC's lack of competitiveness owing to overstaffing and an aging plant.

A reorganization of BSC along regional lines took effect in 1976, replacing the former product division organization, which had endured since 1970. All six new divisions (Scottish, Scunthorpe, Sheffield, Teesside, Welsh, and Tubes) except Sheffield shared in the losses.

In April, the European Economic Community approved a 150-million-pound ($260 million) loan to BSC; this was the largest loan yet made under the European Coal and Steel Community (ECSC) treaty. It was to finance BSC's investment program at the Redcar and South Teesside works and it brought the total amount loaned to BSC by the ECSC to 390 million pounds ($680 million).

An iron ore reduction plant using North Sea gas was to be built by BSC at Jarrow, east of Newcastle, at a cost of 90 million pounds; production by 1979 would be at the rate of 800,000 tons annually. At Hunterston, Scotland, the ore terminal and reduction plant on the coast near Glasgow were to come into operation by late 1978; the terminal would have a capacity of 4 million tons per year, and the first of two Midrex modules would produce 400,000 tons of reduced iron per year starting in 1978.

Lead and Zinc.—An underground exploration program was planned at the Force Crag mine near Keswick, in the Lake District of Cumbria, which had operated for these metals until early in this century. Reserves at the property, controlled by New Force Crag Mines Ltd. of Toronto, were currently about 16,000 tons with 1.75% lead, 8.6% zinc, and 6.7% barite.

The United Kingdom's lead-zinc production continued to originate as a byproduct of fluorspar mining by Laporte Industries Ltd. in the Peak District of Derbyshire, and as a byproduct of tin mining at the Wheal Jane mine in Cornwall.

Nickel.—A fluidized-bed roaster was to be added to the Clydach, Wales, nickel refinery at a cost of 8 million pounds. The refinery, owned by Inco Europe Ltd., has treated sulfide matte from Canada for 75 years. Upon completion, the roaster also will treat matte from Inco's new laterite mines in Guatemala and Indonesia. Class I and Class II nickel products will be produced. A 90-ton-per-day sulfuric acid plant will take most of the sulfur dioxide byproduct.

Tin.—Relief for the hard-pressed Cornish tin mining industry came during the year in the form of higher prices, which increased to 5,000 pounds per ton by yearend compared with about 3,000 pounds per ton early in the year.

A fourth major producer started production in Cornwall in March 1976, when Cornwall Tin and Mining Ltd. brought Mount Wellington onstream. The mine, located at Baldhu near Truro, was designed to handle 220,000 tons of ore per year and produce about 1,600 tons of tin in concentrate, which would make it the largest tin mine in the United Kingdom. Proven reserves were put at 1 million tons; additional possible ore was approximately 3 million to 4 million tons. Cornwall Tin and Mining was a subsidiary of Prado Exploration Ltd. of Toronto and Excomm of Bermuda.

Marine Mining (Cornwall) Ltd., a subsidiary of a U.S. firm of similar name, received permission to operate two walking platform dredges in St. Ives Bay (and later off Cligga Head and St. Agnes Head) on the north coast of Cornwall. The material would be conveyed 6 kilometers up the Red River to Roscroggan for treatment.

The other three major tin producers in Cornwall were Geevor Tin Mines Ltd., at Pendeen on the north coast, which used a 300,000-pound grant from the Department of Industry to continue developing its sublevel incline to connect beneath the sea with the inactive Levant mine; St. Piran Ltd. with two mines, South Crofty and Pendarves, near Camborne, which was proceeding with a 500,000-pound investment program; and the Wheal Jane mine of Consolidated Gold Fields Ltd. (CGF), which was carrying out a 4-million-pound ($7 million) development plan in the mine and mill. All three were producing approximately 1,000 tons per year of tin.

Tungsten.—A 1-year option to reopen the Carrock Fell tungsten mine, 12 miles west of Penrith, Cumbria, in the Lake District, was granted by the owner, Weco Development Corp. of the United States, to Amalgamated Industrials (AI) in September. Ore reserves at the mine, as determined by the United Kingdom Ministry of Supply in World War II, were inferred to be around 50,000 tons averaging 1% WO_3 in scheelite and wolframite. A mill built on the property by Weco in 1972 was to be reactivated. AI was to obtain 50% of the new venture and Weco, 31.5%.

A tungsten-tin prospect at Hemerdon, east of Plymouth in Devon, was examined by Hemerdon Mining and Smelting Ltd., a Bermuda-based company, through a small-scale core-drilling program. Results were sufficiently encouraging for the company to request permission for a phase 2 drilling program and a pilot concentrating plant. The ore is a kaolinized granite, and production of byproduct kaolin would be significant.

Production of tungsten in ore in the United Kingdom is not officially reported, but it has been only a few tons annually in recent years. Tungsten occurs associated with tin in Cornwall and in the granites of the Lake District of Cumbria.

NONMETALS

Fluorspar.—Oversupply led to only small growth in fluorspar output, but companies in both producing areas, Derbyshire and Durham County, continued to plan for increases when the market improved.

Five applications for assistance in fluorspar exploration were made to the Department of Industry between April 1975 and March 1976, under the Mineral Exploration and Investment Grants Act of 1972.

Laporte Industries Ltd., the largest producer, received permission from the Secretary of State, after a refusal by the local planning authority, for construction of a tailings pond at its Cavendish mill near Blakedon, Derbyshire, which treats ore from all of its mines. Output from the Ladywash and Sallet Hole mines near Eyam, Derbyshire, also was to be expanded.

The concentrating plant at Hopton, Derbyshire, operated by C. E. Giulini (Derbyshire) Ltd., which treated ore from several local mines, was shut down during the year.

The Weardale Lead Co., a subsidiary of ICI Ltd., blocked out about 800,000 tons of ore in the Greenclough Vein in the Rookhope Valley, Durham County, and received permission to plan for a new mine there.

Swiss Aluminium Mining (UK) Ltd. (SAMUK) reactivated a project for a 160,000-ton-per-year processing plant at Frosterley, Durham County; this plant is to produce 70,000 tons per year of acid-grade fluorspar. The plant will treat ore from the nearby SAMUK mines under development, including the Cornish Hush, Stanhopeburn, and Cambokeels properties. SAMUK also was negotiating to acquire Weardale from ICI.

BSC received permission during 1976 to erect a fluorspar-concentrating plant at West Blackdene to serve four mines it holds in the Northern Pennine area of Durham County: The Beaumont, Blanchland and Groverake mines near Allenheads, and the Blackdene mine near Stanhope.

Fertilizer Materials.—*Nitrogen.*—The Scanitro project, planned to produce about 350,000 tons of ammonia per year at Peterhead, Scotland, was delayed during the entire year by failure to receive planning permission from the local authorities, the Banff and Buchan District Council; permission had already been obtained from the Scottish Secretary of State. It was reported that the local council delay was caused by a request to Scanitro for financial support for infrastructure projects. Scanitro, controlled by Norsk Hydro and Supra, two Scandinavian fertilizer producers, was to use natural gas piped from the United Kingdom-Norwegian Frigg Field in the North Sea.

Shellstar Ltd., a subsidiary of Unie Van Kunstmestfabriken (UKF), controlled by DSM of the Netherlands, still planned to erect a second ammonia plant on its site at Ince in Cheshire, near Liverpool, but was awaiting planning permission from the Secretary of State for the Environment.

The nine ammonia plants in the United Kingdom had a total capacity in 1976 of about 1.65 million tons per year.

Potash.—About 3 years after the originally scheduled startup date, production continued to be delayed at the Boulby mine of Cleveland Potash Co. in the North Yorkshire Moors National Park; the problem was mainly the erratic nature of the potash seam. The potash bed is extremely variable in thickness and undulating, and has a weak roof. Less than 50,000 tons of K_2O was produced in 1976, compared with a scheduled capacity of 1 million tons per year. Additional funds were allocated by the parent companies, Charter Consolidated and ICI, for mine operation and improvements.

Early in 1977, CGF reached agreement with Shell International Petroleum Co., Ltd., for the purchase of Shell's Whitby Potash Ltd. subsidiary, which holds exploration rights and mineral options over approximately 12,000 acres near Whitby. The potash deposit, which lies at 4,000 to 5,000 feet, would be mined by solution, and the resultant brine would be treated at a plant to be built on the outskirts of Whitby. The projected rate of 450,000 tons annually of K_2O took into account (1) the growth of the United Kingdom market, presently about 750,000 tons per year, (2) the fact that Cleveland Potash would wish to export part of its production to fulfill requirements of its parent companies, and (3) the production difficulties Cleveland Potash was experiencing.

Salt.—BP Chemicals International Ltd. announced that it would close down its natural brine mine at Sandbach, Cheshire, because of subsidence problems. British Salt would in the future supply natural brine to BP from a new brinefield at Warmingham.

Salt production was concentrated in Cheshire, south of Manchester, where Triassic beds yield rock salt, natural brine, and brine from solution mining; an undisclosed amount of rock salt was produced in Northern Ireland. The following tabulation lists the producers in Cheshire during 1976:

Ownership	Mine location	Product	Capacity (million metric tons per year)
ICI Ltd. (Mond. Div., Salt Group).	Winsford	Rock salt	2.5
	Northwich (solution mining).	Vacuum salt	1.2
		Salt in brine	5.5
British Salt Ltd. (Staveley Industries, 75%; Ranks, Hovis, McDougall, 25%).	Middlewich (solution mining).	Vacuum salt	.8
Ingram and Thompson and Sons, Ltd.	Marston	Natural brine	Small [1]
New Cheshire Salt Ltd	Wincham	----do	Small [1]
Total			[1] 10.5–11.0

[1] Estimates are included in total.

Actual production of salt was only about 75% of capacity during the year, mainly because mild weather reduced demand for rock salt for road de-icing to only about one-quarter of capacity.

Strontium.—Production of celestite (strontium sulfate) in 1976 more than doubled that of 1975, and a further increase was expected. Output was mainly exported to other European countries.

The United Kingdom is one of the world's leading producers of celestite. The only mine is operated by the British Mineral Co. Ltd. near Yate, northeast of Bristol. The mineral occurs in the Keuper Marl, of Triassic age, and is mined in shallow surface pits, followed by hand sorting, crushing, and washing.

MINERAL FUELS

Almost two-thirds of the British consumption of energy was supplied in 1976 by domestic production, compared with less than 60% in 1975. Although the bulk (58%) of domestic energy production was coal, the contribution of North Sea oil increased from 1% in 1975 to 10% in 1976.

Table 4 presents the balances of fuel and power production in the United Kingdom in 1975 and 1976.

Coal.—Closely following development of the Selby coalfield was the announcement of unexpectedly large reserves found in the Vale of Belvoir, southeast of Nottingham, a rural area of scenic beauty. National Coal Board (NCB) officials, in esti-

Table 4.—United Kingdom: Supply and apparent consumption of fuels and power for 1975 and 1976

(Million tons of standard coal equivalent [1])

	Total energy	Coal and coke	Petroleum and refinery products	Natural gas	Hydroelectric and nuclear power
1975:					
Production	194.7	129.5	2.3	52.1	10.8
Imports	156.7	5.0	150.4	1.3	[2]
Exports	22.2	[3] 2.1	[3] 20.1	--	[2]
Apparent consumption	329.2	132.4	132.6	53.4	10.8
1976:					
Production	209.5	121.8	20.3	54.7	12.7
Imports	146.3	2.8	142.0	1.5	[2]
Exports	24.5	[3] 1.4	[3] 23.1	—	[2]
Apparent consumption	331.3	123.2	[4] 139.2	56.2	12.7

[1] 1 ton standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Less than ½ unit.
[3] Includes bunkers.
[4] Includes refinery fuel and losses.

Source: Adapted from Department of Energy, "Energy Trends," London, August 1977, 8 pp.

mating the reserves as at least 450 million tons of recoverable coal, declared it to be the largest such discovery in Western Europe in modern times. Reserves in the Selby area, announced in 1975, totaled about 400 million tons of recoverable coal. Six seams were delineated in the Vale using about 80 boreholes and 250 miles of seismic survey. Seam depths ranged from 1,300 to 2,790 feet, over an area of 90 square miles. Two seams lie beneath the Vale: The Deep Main, which averages 8.5 feet thick, and the Parkgate, 9 feet thick. Together, these seams account for 220 million tons of coal. In late 1976, it was announced that the two Vale seams hold additional reserves amounting to 90 million tons in the southwest, west of Melton Mobray. East of the Vale, toward Grantham, the two seams are not in evidence; however, two others are workable, the Top Bright (5 to 17 feet thick) and the Dunsil-Waterloo (5 to 7 feet thick), which together hold about 140 million tons. Total recoverable reserves in the Vale were expected to ultimately exceed these figures considerably.

In June, a consultant's report recommended the establishment of a colliery to produce 3 million tons of coal per year at Hose, in the Vale. The subsequent discovery of the magnitude of the reserves around Melton Mobray and Grantham led to the possibility of establishing mines at Ashfordby and Saltby as well. Opposition on environmental grounds was expected to be strong.

The NCB's intense exploration program produced other concrete results: About 50 million tons of coal was discovered under the Firth of Forth off Musselburg, Scotland, leading to an expectation of eventual production of 500,000 tons of coal per year from seven seams ranging from 1 to 3 meters thick; a 2.4-meter seam was located in an area between Bantry and Blyth, Nottinghamshire; and new reserves were located northwest of Coventry in Warwickshire.

The United Kingdom's first new coal mine in 12 years, Kellingley colliery at Royston, northern Yorkshire, was officially opened in September; it will produce 400,000 tons per year for more than 30 years. Mining will be done using a highly mechanized retreat method on three relatively thin (26 to 47 inches) seams: Sharlston Top, Sharlston Low, and Sharlston Yard, ranging from 200 to 450 feet below the surface. Production efficiency was expected to be more than twice the industry average, and estimated cost of production was less than 7 pounds per ton, compared with over 16 pounds for the industry at large.

In December, the chairman of the NCB reviewed the progress to date on the NCB's Plan for Coal and stressed the significance of the opening of the Royston mine as the forerunner of many larger projects. About 47 million tons of new capacity (including 22 million tons at existing mines) would be commissioned through 1985, thus maintaining the present output level of about 120 million tons per year. Thereafter, expansion and new mine development would provide for an increase to a provisional target of 150 million tons annually by the year 2000. The first phase of halting the present decline of 2 million to 3 million tons per year in coal capacity was to be attained through a three-pronged attack, involving exploration, modernization, and technological advances. This provisional target, however, was to be expanded by a new "Plan 2000", presented by the NCB as a means of offsetting reduced availability of oil and gas after 1985. The new target chosen was 170 million tons per year, corresponding to the average of an estimated range of 135 million to 200 million tons in which demand would probably fall; 150 million tons of this would be mined underground and 20 million tons on the surface. At yearend a review of the Plan for Coal by the Government, unions, and NCB management indicated the possibility of severely higher costs than originally estimated owing to higher wages, original underestimates, added projects, and inflation. The cost could possibly be at least 3,200 million pounds in the period through 1985, in contrast to the 1,400 million pounds originally estimated.

About 240 coal mines were in operation in the United Kingdom in 1976, employing 246,000 persons. Average production was about 2,000 tons per working day per mine; the largest mines were in the 4,000- to 5,000-ton-per-day range. Only 9 million tons per year was won in opencast mines. Of the total production, about 20 million tons per year was coking coal. All mines

were nationalized and operated under control of the NCB, either directly or, as in the case of some opencast mines, by contractors.

Petroleum.—The year 1976 was the first in which substantial quantities of North Sea oil came ashore. Five more oilfields came onstream, for a total of 7 (out of 14 fields considered "commercial"). The 7 oilfields were producing at a combined rate of 25 million tons annually by year-end; actual production totaled 12 million tons in 1976. During the year, the United Kingdom Government decided to offer approximately 50 to 60 offshore blocks for sale. The blocks awarded will be largely in the western approaches to the English Channel, the Celtic Sea, and unexplored areas in the Moray Firth area of the North Sea. Proposed licensing terms were published in a document entitled "United Kingdom Offshore Petroleum Production Licensing—Fifth Round: A Cumulative Document." Principal proposed licensing terms were as follows: The license was to be used solely at the discretion of the Secretary of State for Energy; and the royalty rate would remain at 12.5%, although the effective rate would be higher, since costs of transporting and treating and rental fees would not be deductible against the tax value base. The document also set out guidelines on the relationship between the British National Oil Corporation (BNOC) and its colicensees. BNOC is entitled to a 51% share in all benefits and a vote appropriate to its having a 50% share. Under provisions of the act, product licenses will be awarded for an initial period of 4 years, after which licensees would be required to surrender not less than one-third of the block. After an additional 3 years, another one-third must be relinquished. Licensees might then opt to continue the license for another 30 years on the remaining one-third. The term of exploration licenses was increased from 3 years to 6 years.[3]

Taxation of North Sea oil was announced by the British Treasury in March 1976. The tax will be at a single rate of 45% on gross oil revenues from the United Kingdom's sector of the North Sea. Production of 20,000 barrels per day or less will be tax-free for 10 years. In some instances, the Government will refund the 12.5% royalty and permit a 175% tax credit on capital expenditures during the first year of production.[4]

Exploration.—Exploration for oil and natural gas was conducted onshore and offshore in the United Kingdom. The largest part of the offshore exploratory activities was in the North Sea. In addition, offshore wells (all dry) were drilled in the Bristol Channel, Irish Sea, Cardigan Bay, and West Shetland Basin. The following tabulation shows the location of the 11 onshore and offshore exploration wells drilled in the United Kingdom outside the area of the North Sea:

[3] U.S. Embassy, London. State Department Airgram A-423, June 15, 1976.
[4] U.S. Embassy, London. State Department Airgram A-344, Apr. 10, 1977.

Company and well	County or offshore area	Total depth, feet (meters)	Result
Onshore wells:			
Candecca, Hatfield 1A	York	NA	Drilled and abandoned, hydrocarbon shows.
Candecca, Axholme 3	Lincoln	3,850 (1,173)	Drilled and abandoned.
Candecca, Home, Gas Council, Malton 2.	York	NA	Drilled and abandoned, hydrocarbon shows.
Shell, Consolidated, Bicester 1.	Oxford	NA	Drilled and abandoned.
Offshore wells:			
Amoco (UK) Limited, 103/21–1.	Bristol Channel	NA	Do.
Cluff, 112/30–1	Irish Sea	NA	Drilled and abandoned, cored and tested at 270-foot intervals.
Hydrocarbons–GB, 110/2–3	----do	4,614 (1,406)	10 million to 15 million cubic feet of gas per day.
Hydrocarbons, Deminex (London) Ltd., 106/28–1.	Cardigan Bay	NA	Drilled and abandoned.
Shell, Total Oil Marine Ltd., 206/5–1.	West Shetland	12,000+ (3,650+)	Drilled and abandoned, drilled at water depth of 933 feet (284.6 meters).
Shell, 103/18–1	Bristol Channel	NA	Drilled and abandoned.
Texaco Ltd., 103/2–1	Cardigan Bay	NA	Drilling Dec. 31, 1976.

NA Not available.

In the North Sea, 72 exploratory wells and 29 extension and delineation wells were drilled during 1976. Exploratory drilling declined 22% during 1976, compared with that of 1975. Several new discoveries were reported, the most important of which was the Beatrice Field, only 25 kilometers off the coast of Scotland in Moray Firth. In previous years, eight dry holes had been drilled in the western Moray Firth Basin. Estimates of crude oil reserves of the Beatrice Field ranged from 55 million to 71 million cubic meters (350 million to 450 million barrels).

During the year, BP commenced an active program to assess the size of the Magnus Field, the northernmost field found to date in the North Sea. The productive area was extended, increasing reserves to an estimated 63 million cubic meters (400 million barrels). However, not all results of drilling in the North Sea were favorable. The Brae discovery in the Jurassic was confirmed by one well, but two other step-outs were dry, and early estimates of reserves were lowered significantly. Two new fields found west of the Norwegian Cod Field appeared to be small.

Only four exploratory wells were drilled in southern areas of the United Kingdom's North Sea. In one, Phillips Petroleum U.K. Ltd. made a significant discovery in the lower Permian Rotliegendes sandstone west of the North Viking gasfield.

Five new oilfields, Auk, Montrose, Beryl, Brenda, and Piper, started production in the North Sea during 1976; yearend production, including oil from the Argyll and BP Forties Fields started in 1975, reached an annual rate of about 25 million tons. However, because of delays, total yearly production reached only 12 million tons (including 400,000 tons of natural gas liquids and 100,000 tons onshore) instead of 15 million to 20 million tons as was expected at the beginning of the year. Reasons for delay included damage to the platform at Auk, an accident on the offshore loading tower at Beryl, and slow drilling operations in difficult seabed conditions at Piper. Work on the Flotta, Orkney Islands, terminal continued, with completion scheduled for early 1977; the terminal will handle oil from Piper and Claymore. Another terminal, Sullom Voe in the Shetlands, was under construction at yearend; startup was set for 1978, when the facility will receive oil from the Ninian and Brent pipeline systems. The following tabulation shows pertinent information on fields in production and under development in 1976:

Field and block number	Licensees and interest in block (percent)	Date of discovery	Estimated date of startup	Estimated proven recoverable reserves (million tons)
Argyll (30/24)	Hamilton Brothers (36), RTZ (25), Blackfriars Oil Company Limited (12.5), The Trans-European Company Limited (2.5), Texaco Ltd. (24).	October 1971	June 1975	NA
Auk (30/16)	Shell Petroleum Company, Ltd. (50), Esso Petroleum Company Ltd. (50).	February 1971	February 1976	8
Beryl (9/13)	Mobil Oil Co., Ltd. (50), Amerada Petroleum Corporation of the U.K. (20), Texas Eastern (UK) Limited (20), British Gas Corporation (10).	September 1972	June 1976	70
Brent (211/29)	Shell (50), Esso (50)	July 1971	November 1976	230
Forties (21/10)	BP (100)	November 1970	November 1975	240
Montrose (22/17)	Amoco (UK) Exploration Company (30.77), British Gas (30.77), Amerada (23.08), Texas Eastern (15.38).	September 1969	June 1976	NA
Piper (15/17)	Occidental Petroleum UK Ltd. (36.5), J. Paul Getty (23.5), Allied Chemical (North Sea) Limited (20), Thomson North Sea (20).	January 1973	December 1976	85
Claymore (14/19)	Occidental (36.5), Getty (23.5), Allied Chemical (20), Thomson North Sea (20).	May 1974	1977	57
Cormorant (211/26)	Shell (50), Esso (50)	September 1972	1979	20
Dunlin (211/23)	Shell (50), Esso (50)	July 1973	1979	80
Heather (2/5)	Unocal Corporation (31.25), Skelly Oil Exploration (UK) Limited (31.25), Tenneco Great Limited (31.25), Norwegian Oil Company DNO (UK) Limited (6.25).	December 1973	1978	20
Ninian (3/3)	Chevron Oil (U.K.) Ltd. (24), BNOC (30), ICI (26), Murphy Eastern Oil Co. (10), Ocean Exporation Company Limited (10).	January 1974	1978	140
United Kingdom, Stratfjord (211/24).	Conoco Ltd. (33-1/3), Gulf Oil (Great Britain) Ltd. (33-1/3), BNOC (33-1/3).	April 1974	1979	59
Thistle (211/18)	BODL (5), Burmah Oil Company, Ltd. (8.15), BNOC (10.85), Deminex (London) Limited (42.5), Santa Fe (U.K.) Limited (22.5), Tricentrol International Ltd. (10), Charterhouse Securities Limited (1).	July 1973	1977	76

• Estimate. NA Not available.

The United Kingdom's petroleum refinery capacity was about 3.0 million barrels per day (150 million tons per year) in 1976; there were 21 refineries. Whether or not this capacity should be expanded was under close examination; there were considerable differences of opinion because of present underutilization, coupled with future large increases in North Sea oil production. Expansion of as much as 22 million tons per year was under examination by the Department of Industry.

Cromarty Petroleum Ltd. received permission from the United Kingdom Highland Regional Commission in February to proceed with its planned 200,000-barrel-per-day export refinery at Nigg Point on Cromarty Firth in Scotland. Land for the site was obtained late in the year, and completion of the $300 million refinery is scheduled for 1980.

A 124-mile-long, 30-inch-diameter crude oil pipeline from the Piper offshore field to Flotta terminal came onstream in early 1976. The following tabulation shows the status of major North Sea pipelines at yearend 1976:

Major North Sea pipelines	Length (miles)	Diameter (inches)	Material conveyed	Operator	Year commissioned
Operating:					
From West Sole to Easington	42	16	Natural gas	British Petroleum Co., Ltd. (BP)	1967
From Leman Bank to Bacton	35	30	----do	Shell and Esso	1968
From Hewett to Bacton	20½	30	----do	Phillips and Arpet Petroleum Limited	1969
From Leman Bank to Bacton	38	30	----do	Amoco (UK) Limited	1969
Do	40	30	----do	Amoco, Shell, Esso	1970
From Leman Bank to Leman Bank	5	30	----do	----do	1970
From Indefatigable to Leman Bank	25	30	----do	----do	1971
From Viking to Mablethorpe	86	28	----do	Conoco Ltd	1972
From Hewett to Bacton	20½	30	----do	Phillips and Arpet	1973
From Leman Bank to Bacton	36	30	----do	Amoco, Shell, Esso	1973
From Rough to Easington	18	16	----do	Amoco	1975
From Ekofisk to Teesside	220	34	Crude oil	Phillips	1975
From Forties to Cruden Bay	111	32	----do	BP	1975
From Piper to Flotta	124	30	----do	Occidental International Oil	1976
Under construction:					
From Frigg to St. Fergus No. 1	225	32	Natural gas	Total Oil Marine Ltd	--
From Frigg to St. Fergus No. 2					
From Cormorant to Sullom Voe (Brent System)	93	36	Crude oil	Shell and Esso	--
From Ninian to Sullom Voe	105	36	----do	BP	--
From Claymore to pipeline (tie-in)	8	30	----do	Occidental	--
From Piper to Claymore	22	16	Associated gas	----do	--
From Brent to St. Fergus	281	36	Natural gas	Shell	--
From Dunlin to Cormorant	17	24	Crude oil	----do	--
From Thistle to Dunlin	7	16	----do	BODL Ltd	--
Completed, but not commissioned:					
From Heather to Ninian	22	16	----do	Unionoil Company of Great Britain	--

Natural Gas.[5]—During 1976, about 39 billion cubic meters of natural gas from offshore fields in the United Kingdom was sold to the British Gas Corp., or approximately 98% of the country's gas requirements. The following tabulation shows natural gas production (for selected years) in the United Kingdom, by field, in million cubic meters:

	1967	1970	1974	1975	1976	Cumulative total to yearend 1976
West Sole Field	5	1,190	1,850	1,850	2,040	15,960
Leman Bank Field	--	8,080	16,190	15,620	15,920	99,950
Hewett Field	--	1,990	7,130	7,730	8,190	40,120
Indefatigable Field	--	--	5,690	6,400	6,560	28,100
Viking Field	--	--	4,850	5,610	6,180	21,620
Rough Field	--	--	--	10	520	530
Total[1]	5	11,270	35,730	37,230	39,410	206,290

[1] Data may not add to totals shown because of independent rounding in source.

All North Sea oilfields produced associated gas in various quantities, but only the Brent Field has shown sufficient quantities to justify a separate gas pipeline to the shore. In 1976 about 860 million cubic meters of associated natural gas was produced from oilfields in the North Sea; only 12% was either sold or used at fields, and the rest was flared. Under terms of production licenses, applications for flaring or reinjecting gas must be submitted for approval to the Secretary of State 2 years before actual operation starts. In 1976, seven fields had permission to flare gas, but these permits were permanent only for the Argyll and Auk Fields where the quantities of gas produced were too small to warrant investments in transportation.

[5] Secretary of State for Energy. Development of the Oil and Gas Resources of the United Kingdom, 1977—A Report to Parliament. Her Majesty's Stationery Office, London, 48 pp.

The Mineral Industry of Venezuela

By Nicholas Theofilos [1]

Venezuela's gross domestic product (GDP) at constant 1968 prices increased 7.1% to $15.8 billion [2] in 1976. The petroleum industry, dominating the economy, accounted for 30% of the GDP, 70% of total Government revenues, and 95% of the country's export earnings. Although the industry employed less than 1% of the labor force, it contributed almost 4% to total wages and salaries. In addition to these direct contributions, the petroleum industry provided a stimulus to the development of other sectors of the economy as well as to social changes throughout the country.

Export sales of crude petroleum and products totaled $8.7 billion in 1976, while local sales amounted to $390 million. The increased oil revenues gave Venezuela the highest per capita GDP in Latin America ($2,200). Venezuela's $8 billion in international reserves was also the highest in the region. The Government succeeded to a large degree in holding inflation at reasonable levels and used a portion of its oil income to provide credits and other forms of financial assistance to other developing nations.

Nationalization of the petroleum industry took effect on January 1, 1976, after many years of debate, with the termination of the 22 private oil concessions. The nationalization law had been signed on August 29, 1975, and was followed by a Presidential decree on August 30, 1975, creating Petróleos de Venezuela (PETROVEN) to administer the petroleum industry effective the beginning of 1976. In accordance with this law, compensation to each of the concession holders and participating companies, primarily U.S.-based multinational firms, was determined to be the net book value of their physical assets less certain specified deductions. Compensation payments to the companies, almost all in the form of negotiable 5-year Venezuelan Government bonds, amounted to $1.02 billion. However, about one-half of this compensation was retained by the Government in a guarantee fund, established by an earlier law, to guarantee the condition of the physical assets upon their eventual reversion to national control and to cover any remaining obligations of the companies. Deposits to this fund, representing 10% of each company's gross accumulated investment in the industry, totaled $551 million, which included some payments made to the fund prior to nationalization.

The emergence of PETROVEN and its 14 operating affiliates made this Government enterprise one of the world's largest oil groups. The company acquired 21,000 oil wells (of which 11,870 were producing), 18.3 billion barrels of oil in proven reserves, 11 refineries with a total capacity of 1.6 million barrels per day, 10,000 kilometers of oil and gas pipelines, a tanker fleet, terminals, and a work force of 23,600.

Mining, the country's second most important export sector, declined 27.1% in 1976, owing to a general contraction in steel production in industrialized countries that purchase Venezuela's iron ore. Nevertheless, the iron ore industry benefited from higher export prices and earned $279 million on sales of 18 million tons of ore.

The Government of Venezuela, working through Corporación Venezolana de Gua-

[1] Foreign minerals specialist, International Data and Analysis.

[2] Where necessary, values have been converted from Venezuelan bolivars (Bs) to U.S. dollars at the rate of Bs4.30 = US$1.00.

yana (CVG), was actively engaged in the development of a major aluminum industry that would be based upon the cheap hydroelectric power available in the Orinoco region. In anticipation of future electric power requirements for the proposed aluminum smelters, CVG was expanding the hydroelectric power generating facilities of its wholly-owned subsidiary Electrificación del Caroní C.A. (EDELCA). The creation of the aluminum production complex in Ciudad Guayana was contributing additional pressures on the region's infrastructure. Construction programs in the area included the Guri Dam expansion and major expansion of the national steel mill, as well as inauguration of several new smaller private and joint venture industries. The population of Ciudad Guayana grew from 3,800 in 1950 to 300,000 in 1976, with a current growth rate estimated at 15% to 20% per year.

The Consejo Nacional para el Desarrollo de la Industria Nuclear (CONAN) (National Council for the Development of the Nuclear Industry) was placed under the jurisdiction of the Ministry of Energy and Mines by an executive decree on November 2, 1976. CONAN expected to install the first of 14 nuclear powerplants by the late 1980's. The remaining 13 were scheduled to be constructed by the year 2000. Exploration work for uranium was carried out in the southern and eastern regions of the country. Exploration teams gathered a few tons of uranium ore which was expected to yield the first purified uranium ever produced in Venezuela. The Government was optimistic that the quantity of uranium discovered was sufficient to supply Venezuela's requirements in meeting her objectives.

PRODUCTION

Venezuela's mineral industry in 1976 continued to be dominated by the production of petroleum and iron ore. The output of crude petroleum declined slightly from that of 1975 because of the Government's efforts to conserve. An average of 2,294,000 barrels of oil per day was produced, plus 70,000 barrels per day of natural gas liquids. Iron ore production declined significantly from that of 1975, owing to a decrease in world demand for steel which, in turn, was linked to the global recession of 1975–76. The other sectors of the country's mineral industry registered mixed performance during 1976.

Table 1.—Venezuela: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]		1974	1975	1976 [p]
METALS				
Aluminum, unalloyed ingot		[r] 39,200	49,700	46,500
Gold, mine output, metal content	troy ounces	16,966	18,326	15,645
Iron and steel:				
Iron ore and concentrate	thousand tons	26,424	24,772	18,140
Metal:				
Pig iron	do	545	535	427
Steel ingots and castings	do	1,054	1,061	937
Semimanufactures	do	[r] 862	962	1,066
NONMETALS				
Cement, hydraulic	do	3,494	3,497	3,538
Clays, crude: Kaolin		17,408	15,000	10,000
Diamond:				
Gem	carats	279,500	238,691	192,782
Industrial	do	969,500	821,341	640,454
Total	do	1,249,000	1,060,032	833,236
Feldspar		23,460	20,000	10,000
Fertilizer materials:				
Crude: Phosphate rock, marketable		[r] 141,100	116,400	80,000
Manufactured: Nitrogenous, N content [2]		47,700	50,000	NA
Gypsum		164,500	211,686	175,000
Salt, all types		223,173	289,849	[e] 300,000
Stone, sand and gravel	thousand tons	6,264	6,500	8,000
MINERAL FUELS AND RELATED MATERIALS				
Carbon black [e]		18,000	17,000	19,000
Coal, bituminous		57,086	60,127	89,219
Gas, natural:				
Gross production	million cubic feet	1,639,511	1,342,034	1,311,392
Marketable production	do	475,969	450,295	479,807
Natural gas liquids:				
Condensate	thousand 42-gallon barrels	[r] 1,252	1,434	1,422
Natural gasoline	do	7,825	7,328	7,271
Liquefied petroleum gas	do	[r] 21,524	18,901	20,524
Total	do	[r] 30,601	27,663	29,217
Petroleum:				
Crude	do	1,086,332	856,364	839,740
Refinery products: [3]				
Aviation gasoline	do	288	242	672
Motor gasoline	do	36,258	39,858	43,344
Naphtha	do	33,694	19,044	22,781
Jet fuel	do	12,521	8,251	9,113
Kerosine	do	3,583	2,966	5,288
Distillate fuel oil	do	48,300	49,938	45,278
Residual fuel oil	do	280,479	178,302	216,028
Lubricants	do	3,753	3,532	2,464
Other:				
Liquefied petroleum gas	do	3,091	2,553	2,643
Asphalt and bitumen	do	3,800	3,442	3,734
Refinery gas [4]	do	5,504	5,283	6,807
Unspecified	do	5,268	3,634	2,734
Total	do	436,539	317,045	360,886

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the commodities listed, lime is produced but information is inadequate to make reliable estimates of output levels.

[2] Format of table changed to show nitrogen content of nitrogenous fertilizers rather than gross weight.

[3] Includes refinery fuels.

[4] Liquid equivalent.

TRADE

Venezuela ranked as the third largest exporter of crude oil and refined products in 1976. However, for the first time in many years, Venezuela was not the single largest supplier of oil to the United States. In 1976, both Saudi Arabia and Algeria shipped greater volumes of oil into the U.S. market, as a consequence of the rapid growth in U.S. imports combined with the decline in Venezuelan exports. Direct exports to the United States averaged 727,000 barrels per day in 1976, two-thirds of which were refined products. This represented 34% of total oil exports,

a percentage that has remained relatively steady through the 1970's. Another third of Venezuela's exports, primarily crude oil, went to the Caribbean refineries (Aruba and Curaçao) for refining and transshipment to end users. About one-half of this oil, in the form of refined products, subsequently went to the United States. Thus, in total, the U.S. market absorbed about one-half of Venezuelan exports for the year.

Approximately 85% of iron ore production was exported in 1976. Although iron ore exports were 19% below those of 1975, income from export sales was 0.6% higher or $252.4 million. The United States was the market for 55% of Venezuela's iron ore exports in 1976.

Table 2.—Venezuela: Exports and reexports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys:			
Scrap	1,437	1,528	Peru 1,194; Colombia 334.
Unwrought	14,344	10,410	Colombia 4,075; Peru 3,405; Argentina 2,730.
Semimanufactures	r 991	171	Costa Rica 100; Netherlands Antilles 32; Brazil 21.
Copper metal including alloys: Semimanufactures	29	19	Mainly to United States.
Iron and steel:			
Ore and concentrate ----thousand tons--	25,850	19,850	United States 11,930; Italy 1,965; United Kingdom 1,667.
Metal:			
Pig iron, ferroalloys, similar materials	r 22,400	(2)	All to Brazil.
Steel, primary forms	r 51,691	(2).	All to Netherlands Antilles.
Semimanufactures	r 6,778	1,649	Ecuador 272; Peru 210; Dominican Republic 201.
Lead metal including alloys, all forms	65	--	
Nickel metal including alloys, all forms	15	23	Mainly to United States.
Platinum-group metals and silver, waste and sweepings ----------troy ounces--	193	--	
Zinc metal including alloys, all forms	536	296	United States 184; Brazil 65.
Other:			
Ores and concentrates, n.e.s	33,773	--	
Ash and residue containing nonferrous metals	488	(2)	All to United States.
Oxides, hydroxides, peroxides of metals	r 30,687	137,861	United States 63,915; Colombia 28,534; Brazil 22,029.
Metals including alloys, all forms, n.e.s	r 53	1	Mainly to Netherlands Antilles.
NONMETALS			
Abrasives, natural:			
Pumice, emery, natural corundum, etc	3	3	Trinidad and Tobago 2.
Grinding and polishing wheels and stones, n.e.s ----------kilograms--	r 1,873	5	Trinidad and Tobago 3.
Asbestos	33	(2)	All to Netherlands Antilles.
Cement, hydraulic	132,703	35,759	Surinam 19,400; United States 6,586; Netherlands Antilles 6,236.
Clays and clay products (including all refractory brick):			
Crude clays, unspecified	401	(2)	Mainly to Ecuador.
Products:			
Refractory	r 2,007	1,548	Argentina 688; Chile 465; Ecuador 133.
Nonrefractory	1,076	598	United States 383; Netherlands Antilles 199.
Diamond, gem ----------thousand carats--	r 1,115	1,240	United States 590; Netherlands 435.
Diatomite	43	--	
Fertilizer materials:			
Crude	3	3	All to Netherlands Antilles.
Manufactured	r 14,451	6,838	All to Dominican Republic.
Gypsum and plasters	15,500	16,960	Mainly to Trinidad and Tobago.
Lime	121	66	Brazil 56; Netherlands Antilles 10.
Pigments, iron oxide	2	--	

See footnotes at end of table.

Table 2.—Venezuela: Exports and reexports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Precious and semiprecious stones, except diamond ----------value, thousands--	$374	$66	Netherlands $39; United States $11; Israel $10.
Salt ----------	25,257	975	Surinam 500; Trinidad and Tobago 475.
Sodium and potassium compounds, n.e.s -----	r 6,618	2,068	All to Netherlands Antilles.
Stone, sand and gravel:			
Dimension stone ----------	r 1,679	1,962	Netherlands Antilles 1,343; Trinidad and Tobago 544.
Crushed and broken stone for cement and lime manufacture ----------	245	114	Netherlands Antilles 74; Trinidad and Tobago 40.
Quartz and quartzite ----------	129	85	Poland 48; West Germany 37.
Sulfur:			
Elemental ----------	30,979	7,419	Colombia 3,731; Peru 3,688.
Sulfuric acid ----------	30,600	13,859	United States 6,500; Netherlands Antilles 4,059; Colombia 2,500.
Other nonmetals:			
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s ----------	24	1,277	Mainly to Netherlands Antilles.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black ----------	3,244	20,493	Argentina 17,126; Ecuador 1,492.
Coal and coke, including briquets ----------	14	--	
Hydrogen, helium, rare gases ----------	r 11	6	All to Trinidad and Tobago.
Natural gas liquids:			
Natural gasoline thousand 42-gallon barrels--	5,963	3,894	United States 3,462.
Liquefied petroleum gas ----------do----	16,210	10,907	United States 4,594; Argentina 1,620; Spain 1,386.
Petroleum:			
Crude and partly refined ----------do----	646,916	541,310	United States 215,619; Netherlands Antilles 135,762; Canada 62,573.
Refinery products:			
Gasoline and naphtha ---------do----	23,386	15,739	United States 10,632; Netherlands Antilles 1,249.
Jet fuel ----------do----	7,559	3,136	United States 2,278; Nigeria 186.
Kerosine ----------do----	84	--	
Distillate fuel oil ----------do----	23,027	25,109	United States 4,844; Netherlands 2,982; United Kingdom 2,015.
Residual fuel oil ----------do----	289,808	166,001	United States 85,730; Netherlands Antilles 39,068.
Lubricants ----------do----	2,729	2,208	United Kingdom 785; Sweden 454; France 268.
Asphalt ----------do----	1,856	529	United States 332; Dominican Republic 141.
Other ----------do----	3,762	3,002	West Germany 1,017; Argentina 676; Sweden 347.
Total ----------do----	352,211	215,724	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ----------	5	--	

r Revised.

[1] Data for 1974 and 1975, excluding natural gas liquids, crude petroleum and refinery products, and iron ore, were derived from official Venezuelan export statistics. Data for the excluded commodities were derived from Ministerio de Minas e Hidrocarburos, Memoria y Cuenta, 1974 and 1975.

[2] Less than ½ unit.

Table 3.—Venezuela: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	6,600	3,545	Mainly from Guyana.
Oxide and hydroxide	r 82,436	62,390	United States 54,082; Jamaica 7,011.
Metal including alloys:			
Unwrought	176	109	Mainly from United Kingdom.
Semimanufactures	r 5,689	8,564	United States 6,549.
Antimony metal including alloys, all forms	16	60	Belgium-Luxembourg 48; United States 11.
Arsenic:			
Natural sulfides	33	--	
Trioxide, pentoxide, acids	53	36	France 23; United States 13.
Chromium:			
Chromite	r 7,842	5,000	Mainly from Philippines.
Oxide and hydroxide	175	131	United States 85; West Germany 25; United Kingdom 13.
Cobalt oxide and hydroxide	10	3	Mainly from United States.
Copper:			
Ore and concentrate	--	5	All from Spain.
Matte	5	--	
Copper sulfate	393	281	Peru 121; United Kingdom 70; West Germany 44.
Metal including alloys:			
Scrap	696	418	United States 331; Belgium-Luxembourg 68.
Unwrought	667	3,866	Mainly from United States.
Semimanufactures	r 15,500	12,898	United States 3,954; Chile 2,711; Canada 1,681.
Gold metal, unworked or partly worked troy ounces	r 3,022	8,102	Mainly from United States.
Iron and steel:			
Ore and concentrate	r 94	58	All from United States.
Metal:			
Scrap	r 170,728	56,174	Mainly from United States.
Pig iron, ferroalloys, similar materials	88,400	168,527	Brazil 132,579; Switzerland 17,724.
Steel, primary forms	r 144,473	549,843	Belgium-Luxembourg 201,983; Japan 133,270; United States 121,039.
Semimanufactures:			
Bars, rods, angles, shapes, sections	r 283,657	198,275	Japan 77,081; United States 44,295; Belgium-Luxembourg 22,692.
Universals, plates, sheets:			
Uncoated	r 511,361	315,400	Japan 157,454; Italy 69,302; United States 49,159.
Coated	r 110,389	94,392	Japan 46,402; France 18,260; United States 13,479.
Hoop and strip	r 6,894	5,418	Japan 1,398; West Germany 1,266; United States 1,186.
Rails and accessories	3,657	8,910	United States 7,021; West Germany 1,123.
Wire	r 9,975	5,038	Japan 2,369; Belgium-Luxembourg 936; United States 684.
Tubes, pipes, fittings	r 119,981	172,146	United States 71,838; Italy 32,194; Japan 28,032.
Castings and forgings, rough	3,498	7,827	United States 5,024; Italy 1,324.
Total	1,049,412	807,406	
Lead:			
Oxides	1,283	1,085	Mexico 808; United States 161.
Metal including alloys, all forms	r 7,311	9,693	United States 5,061; Mexico 1,560.
Magnesium metal including alloys, all forms	r 488	325	Norway 163; United States 152.
Manganese:			
Ore and concentrate	145	103	All from United States.
Oxide	1,780	1,152	Mexico 714; United States 280.
Mercury 76-pound flasks	172	456	Mainly from United States.
Molybdenum metal including alloys, all forms	3	8	United States 4; United Kingdom 3.
Nickel:			
Matte, speiss, similar materials	--	3	Mainly from United States.
Metal including alloys, all forms	r 609	568	United States 410; West Germany 65.

See footnotes at end of table.

Table 3.—Venezuela: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Platinum-group metals including alloys, all forms ---troy ounces--	r 24,370	45,043	Italy 21,445; United States 18,744; Spain 4,533.
Silver metal including alloys ---do---	457,794	437,314	United States 279,518; West Germany 44,400.
Tin:			
Oxides	9	12	Mainly from United States.
Metal including alloys, all forms	326	650	United States 491; Switzerland 60.
Titanium oxides	r 1,829	1,290	Finland 516; United States 178; West Germany 168.
Tungsten metal including alloys, all forms	r 12	10	United States 8; United Kingdom 1.
Uranium metal including alloys, all forms ---kilograms--	1,072	7	All from Belgium-Luxembourg.
Zinc:			
Oxides	1,671	883	West Germany 222; United States 188; Mexico 132.
Metal including alloys:			
Scrap and blue powder	r 1,031	244	United States 125; Canada 86; West Germany 31.
Unwrought	12,398	9,798	Canada 3,417; Mexico 2,754; United States 1,093.
Semimanufactures	r 103	377	Mainly from United States.
Other:			
Ores and concentrates	r 652	417	Australia 186; United States 115; Japan 88.
Ash and residue containing nonferrous metals	9	2	All from United States.
Oxides, hydroxides, peroxides of metals, n.e.s	234	375	United States 208; Belgium-Luxembourg 71; United Kingdom 36.
Metals including alloys, all forms, n.e.s	r 601	631	United States 271; United Kingdom 105; Canada 87.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	218	140	United States 71; Italy 46; West Germany 17.
Grinding and polishing wheels and stones	r 69	86	United States 48; West Germany 13; Austria 10.
Asbestos	9,670	15,548	Canada 10,253.
Barite	53,754	29,923	United Kingdom 17,800; Peru 6,097; United States 5,970.
Boron materials:			
Crude natural borates	r 290	439	United States 174; Argentina 106; Spain 101.
Oxide and acid	258	702	United States 571.
Salts	953	--	
Cement	r 1,580	29,337	United States 15,637; Colombia 12,071.
Chalk	403	518	France 353; Spain 100; Belgium-Luxembourg 50.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Bentonite	17,915	7,419	Mainly from United States.
Kaolin	17,075	16,542	Do.
Other	4,022	3,756	Do.
Products:			
Refractory (including nonclay bricks)	r 2,038	7,666	United States 5,955; West Germany 983.
Nonrefractory	1,960	16,377	Colombia 7,709; Italy 6,464.
Cryolite and chiolite	29	11	United Kingdom 6; Canada 5.
Diamond:			
Gem, not set or strung ---thousands carats--	(1)	770	Mainly from Netherlands.
Industrial ---do---	30	485	United States 330; United Kingdom 60.
Diatomite and other infusorial earth	5,283	3,978	United States 2,201; Mexico 1,706.
Feldspar	399	147	Mexico 90; United States 56.

See footnotes at end of table.

Table 3.—Venezuela: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Fertilizer materials:			
Crude	r 10,950	4	Mainly from United States.
Manufactured:			
Nitrogenous	r 101,606	250,966	Belgium-Luxembourg 83,750; Colombia 40,545.
Phosphatic	18,449	4,587	Mainly from United States.
Potassic	r 11,646	22,859	West Germany 12,358; Netherlands 5,251; Belgium-Luxembourg 5,250.
Other, including mixed	4,631	71	United States 58; Italy 10.
Ammonia	21	--	
Fluorspar	828	390	Mexico 151; Colombia 100.
Graphite, natural	r 396	279	Mainly from United States.
Gypsum and plasters	570	589	United States 220; West Germany 204; United Kingdom 162.
Iodine	6	7	West Germany 3; France 2; United Kingdom 1.
Lime	99	60	All from United States.
Magnesite	4,535	8,691	Mainly from Brazil.
Mica:			
Crude, including splittings and waste	460	412	Mainly from United States.
Worked, including agglomerated splittings	r 21	7	United States 4; Italy 2.
Pigments, mineral:			
Natural, crude	22	56	Mainly from United Kingdom.
Iron oxides, processed	1,662	1,228	Spain 536; West Germany 377; United States 146.
Precious and semiprecious stones, except diamond, natural and synthetic kilograms	18,500	2,919	Brazil 1,497; Mexico 709.
Pyrite	19	37	Mainly from United States.
Salt	133	78	United States 67; West Germany 7.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	r 23,861	65,884	United States 34,837; Italy 10,544; France 10,136.
Caustic potash, sodic and potassic peroxides	2,333	457	United States 346; Czechoslovakia 53.
Soda ash	r 58,852	27,654	United States 24,823; Japan 2,230.
Stone, sand and gravel:			
Dimension stone, crude and worked	7,082	7,890	Italy 6,614; Portugal 655.
Gravel and crushed stone	218	255	Belgium-Luxembourg 202; France 50.
Dolomite, chiefly refractory grade	18,863	33,696	Mainly from United States.
Quartz	188	133	Italy 73; United Kingdom 41; United States 16.
Sand	r 743	252	United States 151; Belgium-Luxembourg 101.
Sulfur:			
Elemental:			
Other than colloidal	282	44	West Germany 33; United Kingdom 10.
Colloidal	r 75	--	
Sulfur dioxide	81	124	Mainly from United States.
Sulfuric acid	r 334	1,741	West Germany 1,156; United States 402.
Talc and steatite	6,910	6,492	United States 4,736; Italy 722.
Other nonmetals, n.e.s.:			
Crude:			
Vermiculite	128	438	NA.
Mineral substances, n.e.s	r 144	20	NA.
Slag, dross, similar waste, not metal bearing	2	3	Mainly from United States.
Oxides and hydroxides of magnesium, strontium, barium	r 7,029	13,241	Mainly from Japan.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	r 1,124	671	United States 410; Surinam 149; West Germany 98.

See footnotes at end of table.

Table 3.—Venezuela: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	r 303	451	All from United States.
Carbon black and gas carbon	r 756	576	United States 270; West Germany 121; Japan 82.
Coal, all grades, including briquets	2,694	7,407	West Germany 4,511; United States 2,549.
Coke and semicoke of coal and lignite	229,639	288,008	Japan 163,884; United States 62,206; West Germany 40,698.
Hydrogen, helium, rare gases	25	42	Mainly from United States.
Peat, including briquets and litter	2	24	Finland 16; West Germany 7.
Petroleum:			
Crude and partly refined 42-gallon barrels	r 1,250	308	United States 273; West Germany 35.
Refinery products:			
Gasoline ---do	r 392	603	United States 337; Belgium-Luxembourg 180; West Germany 64.
Kerosine and jet fuel ---do	r 10,280	1,735	France 1,035; United States 665.
Distillate fuel oil ---do	r 52	1	All from United States.
Residual fuel oil ---do	6	(2)	Do.
Liquefied petroleum gas ---do	944	124	Italy 66; United States 47.
Lubricants ---do	r 67,453	156,129	United States 81,025; Netherlands Antilles 38,115; Brazil 21,548.
Other:			
Mineral jelly and wax ---do	r 32,594	33,051	United States 19,921; Japan 4,138; West Germany 4,018.
Nonlubricating oils, n.e.s ---do	54,639	2	All from United States.
Pitch and pitch coke ---do	47,424	138,115	Japan 105,844; United States 18,462; Colombia 13,138.
Petroleum coke ---do	70,385	110,761	Mainly from United States.
Bitumen and other residues ---do	744	1,693	Japan 1,285; United States 194; Canada 189.
Bituminous mixtures, n.e.s ---do	7,184	1,120	United Kingdom 730; United States 291.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r 6,534	10,220	Mainly from United States.

r Revised. NA Not available.
1 Quantity not available but valued at $145,000 in 1974 and $51,000 in 1975.
2 Less than ½ unit.

COMMODITY REVIEW

METALS

Aluminum.—Aluminio del Caroní S.A. (ALCASA) was Venezuela's sole producer of aluminum in 1976. ALCASA, in 1976, produced 46,500 tons of aluminum, and consumed 850,000 million watt-hours of hydroelectric power. Expansion of the Guri Dam, combined with a growing Latin American market for aluminum, encouraged ALCASA to launch a major expansion program, including a new 70,000-ton potline. The expansion program was executed under a construction contract with Reynolds International. By the end of 1976, $87.6 million of a planned investment of $155.6 million had been spent on the project, which was scheduled for completion by the end of 1977.

Most of the additional 70,000 tons of aluminum to be produced in 1978 was to be sold in the export market. In the longrun ALCASA hoped to encourage the development of a broad variety of aluminum fabricating industries in Venezuela.

The Venezuelan Government was encouraging the development of aluminum rolling mills in the Guayana region. One U.S. firm, Southwire Co., was already involved in a joint venture project in Venezuela. Southwire owned 49% of a new company, Suramericana de Aleaciones Laminadas, C.A. (SURAL), with the remainder of the stock held by private Venezuelan interests. The SURAL plant, with an initial annual capacity of 10,000 tons of aluminum alloy rods, was to ex-

pand as the available supply of aluminum increased. The additional aluminum was expected to be supplied by Industria Venezolana de Aluminio C.A. (VENALUM), Venezuela's second major aluminum facility, which was scheduled to start production by the end of 1977.

Copper, Lead, and Zinc.—The Government was accepting bids to select two companies to participate in a project to exploit the reserves of copper, lead, and zinc at Bailadores, in the State of Mérida. The deposit was estimated to contain 3 million tons of ore grading 26% zinc, 7% lead, and 1.5% copper. Provisions were made for the formation of two mixed companies in which the Venezuelan Government would have a 70% interest. The first company was to exploit the deposit and provide concentrating facilities for the minerals, while the second company was to provide processing operations for the concentrates.

Iron Ore.—Ferrominera Orinoco C.A., a wholly-owned subsidiary of CVG, completed its first year of operations in 1976 following the reorganization of the iron ore industry in late 1975. Since the nationalization took effect on December 31, 1975, the iron ore industry functioned in an unusually smooth fashion, reflecting Venezuela's awareness of the continued need for technical and marketing assistance from the former concessionaires. In practice, there was little change in operation of the mines. The same work force and managers continued to work the 8,600 hectares in El Pao that formerly belonged to the Iron Mines Co. of Venezuela (a subsidiary of Bethlehem Steel Corp.) and the 8,093 hectares in 18 concessions in the Heres District of Bolívar State that belonged to Orinoco Mining Co. (a subsidiary of United States Steel Corporation). Forward iron ore supply contracts were signed with United States Steel and Bethlehem Steel to assure them a predetermined but declining percentage of total ore production as consumption in Venezuela increased. Similar contracts were signed with several European firms. Although the earnings from these exports were considered important and had their place in CVG budgeting for the next few years, they were not an overriding consideration. The Venezuelan Government had adopted a policy of conservation of iron ore reserves. The Government intended to hold production at current levels for the indefinite future and eventually to absorb all of the production in the expanded steel industry.

Iron ore shipments of Ferrominera in 1976, by destination, are given in the following tabulation, in thousand tons:

	Shipments
United States	9,797
Italy	1,989
Germany, West	1,892
United Kingdom	977
Spain	830
Belgium	606
France	556
Netherlands	416
Czechoslovakia	245
Poland	49
Portugal	31
Argentina	14
Domestic market	98
Total	17,500

Iron and Steel.—The State-owned CVG Siderúrgica del Orinoco C.A. (SIDOR) was in its second year of carrying out an expansion scheme that was to raise steel output from the present peak capacity of 1.2 million tons per year to 5 million tons of liquid steel per year. The expansion was the most costly program being financed by the Venezuelan Government, and it was expected to be completed by the early to mid-1980's.

The expansion will involve building a massive new steel mill alongside the existing facility. The steel plant is to be fed from nearby Government-owned high-grade iron ore mines, and powered by the Government-owned Guri hydroelectric complex on the Caroní River. The new steel project was coordinated by the State regional development agency, Corporación de Desarrollo de la Region Zuliana (CORPOZULIA), and was expected to be formally established before the end of 1977.

There were several areas of uncertainty regarding the new steel project that had to be clarified before work could begin. The two most important were financing and the absence of a foreign partner in the project. If the project is to be wholly Government owned, it seemed possible that the Venezuelan Investment Fund would be called upon to provide most of the financing. If non-Government participation is to be permitted, a substantial amount of financing might be provided by the foreign

partner in the form of equity plus supplier's credit or loans to the Government for its equity share. Several consortia, led by Japanese and Western European firms, presented proposals to the Venezuelan Government for the project as well as for the related coal, electric power, and infrastructure projects.

MINERAL FUELS

Coal.—During 1976 five private mines at Lobatera, in the State of Táchira, produced 89,200 tons of coal, a 48% increase over that of 1975. The Ministry of Energy and Mines gave CORPOZULIA permission to tap the large seams of bituminous coal near the Colombian border in the State of Zulia. Proven reserves were estimated at 780 million tons, 190 million tons of which could be mined by open pit methods. An analysis of samples showed that the coal is low ash (4% to 6%), low sulfur (0.4% to 0.8%), high volatile (39% to 40%), and not ideal for coking purposes. For the coal to be used in the integrated steelworks, as projected for the State of Zulia, it would have to be mixed with up to 70% foreign coal.

The Government was also beginning to put plans into effect to bring back into production the coal mines at Naricual near Barcelona. This area was expected to add 500,000 tons of coal per year to the country's production. Washing tests were expected to be completed by 1977. If the results are positive, the coal was expected to be utilized by SIDOR.

Petroleum and Natural Gas.—Venezuela's petroleum industry operated satisfactorily after the Government takeover on January 1, 1976. Employment totaled 23,600. Multinational companies, working under contract, provided technological and marketing expertise in accordance with policy directions given by the board of directors of PETROVEN, the holding company. All outstanding stock of this company was held by the Government. The Minister of Energy and Mines, as chairman of the company's General Assembly, sets the general policy. PETROVEN was initially capitalized at $584 million but at the end of 1976 this was increased to $2.49 billion, comprising the original capital plus the capital assets of Corporación Venezolana del Petróleo S.A. (CVP), the original State oil company.

Management of the industry was entirely in the hands of PETROVEN which controlled 14 operating companies, most of which were former affiliates of foreign oil concerns. The board of directors operated through a series of committees, each representing a major function of the industry. A board member chaired each committee, and the holding company's coordinator for that function served as its secretary.

The Ministry of Energy and Mines was charged with the responsibility of administering Venezuela's conservation program. Production of petroleum was to be held at about 85% of capacity, and crude oil prices were set in accordance with prices established by the Organization of Petroleum Exporting Countries (OPEC). The Ministry was also responsible for assigning geographical areas to the operating companies for exploration. During 1976, PETROVEN subsidiaries were limited to the concession areas originally assigned to their private predecessors.

Petroleum research was carried out by the Venezuelan Technological Institute of Petroleum. This entity was created at the time of nationalization and was given the responsibility of providing technological support to the petroleum and petrochemical industries, enabling them to reduce their dependence on foreign technology. During 1976, the Institute was working with CVP on a project in the Melones District to test in situ combustion in the recovery of heavy oils.

Exploration and the development of new production capacity were to receive priority by PETROVEN in the immediate future. Activities in this area had been stagnated in recent years by the concessionaires' reluctance to invest in view of uncertainties as to their future status and the Government's unwillingness to open up new areas for exploration. This was complicated by the lack of integrated functioning exploration groups within the industry. Another constraint on exploration and production drilling was the shortage of drilling rigs. As a result, additions to reserves attributable to new discoveries (as opposed to revisions in the amount of recoverable reserves from known fields) had fallen behind production levels.

In 1976, 44 wildcat wells were drilled compared with an average of 33 per year

for the previous 5 years. Twenty-two of these wells were successful, adding slightly over 100 million barrels to proven reserves. The only surface exploration work was seismic, which involved 38 crew months, 40% less than in 1975. Land surveys totaled 5,244 square kilometers mostly in the Anzoátegui, Zulia, and Monagas areas. Surveys in Lake Maracaibo totaled 3,359 square kilometers, and off the north coast, 2,265 square kilometers.[3] Plans for exploration activities for 1977 included the drilling of 75 exploratory wells and the extension of the seismographic program. Areas of interest for exploration, in order of priority, were onshore areas adjacent to known fields; offshore areas, including the Amacuro Delta and the Gulfs of Paria, Triste, and La Vela; and the Orinoco Heavy Oil Belt.

Crude oil production in 1976 averaged 2,294,000 barrels per day, plus 70,000 barrels per day of natural gas liquids. There were 11,870 actively producing wells at the end of the year, giving an average production of 193 barrels per day per well. In addition, there were 9,360 shut-in wells capable of production, with an estimated capacity of 300,000 to 400,000 barrels per day, almost all of which was heavy crude. A total of 285 new production wells were drilled and over 1,400 existing wells were reconditioned in 1976, with the total investment in production activities amounting to about $200 million. The distribution of crude oil production in 1976 by gravity, region, and operating subsidiary of PETROVEN, in thousand 42-gallon barrels per day, is shown in the following tabulation:

	Production	Percent
By gravity:		
Light (over 30° API)	898	39
Medium (22° to 30° API)	852	37
Heavy (below 22° API)	544	24
By region:		
Lake Maracaibo area	1,833	80
Eastern Venezuela	423	18
Other	38	2
By operating company:		
Lagoven S.A	995	43
Maraven S.A	534	23
Meneven S.A	357	16
Palmaven S.A	111	5
Other	297	13

Proven reserves at yearend were calculated at 18.3 billion barrels, about 1% below the level of a year ago. The reserves were believed to be sufficient to sustain production at the current rate for about 20 years. However, heavy gravity crude accounted for 43% of these reserves, medium for 30%, and light for 27%. Thus, emphasis was expected to be placed on the discovery of light crudes or the marketing of a greater proportion of the more abundant heavy oils.

Drilling programs for 1977 called for the completion of 350 to 450 production wells. Another major area of future investment was that of secondary recovery. Both Maraven S.A. and Lagoven S.A. were working on major steam injection projects to increase the recovery.

Natural gas production, almost all associated gas, amounted to almost 38 billion cubic meters in 1976. About 56% of this was reinjected into the oil bearing formations, 36% was sold for domestic consumption or used by the industry itself, and 8% was flared. Major projects to extract natural gas liquids from associated gas in eastern Venezuelan fields were under study. Proven reserves of natural gas were estimated to be 1.15 trillion cubic meters.

Venezuela's 11 operating refineries had a capacity of 1,554,000 barrels per day in 1976. Refinery throughput increased from 860,000 barrels per day in 1975 to 984,000 barrels per day in 1976. This represented a refinery capacity utilization of 63%. The petroleum industry faced falling gasoline production in 1976 because the refineries were originally designed to maximize production of residual fuel oil, yielding only about 20% gasoline by volume. Some flexibility in the yield was expected to be obtained from lighter gravity crudes, once these crudes become more available.

To meet the growing domestic demand for gasoline and to increase processing capacity for the more abundant heavy crudes, PETROVEN embarked on a program to upgrade its major refineries over the next 5 years. Detailed engineering was underway for a $33 million project to revamp the catalytic cracker at the Maraven S.A. refinery at Cardon. This was expected to add 14,000 barrels per day to the refinery's gasoline production by 1979.

[3] American Association of Petroleum Geologists Bulletin. V. 6, No. 10, October 1977, p. 1592.

Approval was also given to a project to add another 53,000 barrels per day in gasoline capacity by mid-1980 through the upgrading of Llanoven S.A.'s El Palito refinery at Puerto Cabello. The project, to include installation of a vacuum distillation unit, a catalytic cracker, and an alkylation unit, was expected to cost about $210 million. A much larger project involving an extensive reworking of Lagoven S.A.'s Amuay refinery, one of the world's largest, was also under consideration. Gasoline production was planned to increase by 60,000 barrels per day by mid-1982. This project was also to include additional catalytic cracking capacity as well as installation of various other units, at an estimated cost of over $600 million.

Venezuela's most important client continued to be the United States, and PETROVEN expected the relationship to continue. In 1976, the Government oil company shipped 88% of its exports (by volume) to markets in the Western Hemisphere, chiefly the United States, Canada, and Caribbean countries. Crude oils constituted about two-thirds of these exports and refined products, chiefly fuel oils, made up the remainder.

PETROVEN, which already maintained a fleet of 20 oil tankers, was planning to purchase 14 additional ships by 1982. Aside from the standard practice of replacing old ships, PETROVEN wanted to expand its tanker capacity to achieve greater flexibility in supplying new customers. The new ships would be in the 30,000- to 60,000-deadweight-ton range. PETROVEN's 1976 fleet amounted to 700,000 deadweight tons and was made up of 10 ships owned by the company and 10 under lease.

Table 4.—Venezuela: Wells drilled, crude oil production, refinery production, and refining capacity, 1976

(Thousand 42-gallon barrels per day)

PETROVEN operating company	Former principal concessionaire			Wells drilled	Crude oil production	Refinery production	Refinery capacity
	Company	Principal ownership or affiliation	Nationality of ownership				
Amoven S.A	Amoco Venezuelan Oil Co	Standard Oil Company (Indiana)	United States	13	24	--	--
Bariven S.A	Sinclair Venezuelan Oil Co	Atlantic Richfield Company	----do	--	19	30	45
Boscaven S.A	Chevron Oil de Venezuela S.A	Standard Oil Co. of California	----do	--	22	32	61
CVP	CVP	Government of Venezuela	Venezuela	36	60	15	25
Deltaven S.A	Texaco Maracaibo Inc	Texaco Inc	United States	7	60	2	10
Guariven S.A	Soc. Anonima Petrolera Las Mercedes.	Venezuelan investors	Venezuela	7	2	--	--
Lagoven S.A	Creole Petroleum Corp	Exxon Corp	United States	132	1,004	425	740
Llanoven S.A	Mobil Oil Co. de Venezuela	Mobil Oil Corp	----do	7	67	88	106
Maraven S.A	Cia. Shell de Venezeula Ltd	Royal Dutch/Shell Group	United Kingdom and Netherlands.	10	531	259	404
Meneven S.A	Mene Grande Oil Co. C.A	Gulf Oil Corp	United States	109	364	127	159
Palmaven S.A	Venezuelan Sun Oil Co	Sun Oil Co	----do	3	104	--	--
Roqueven S.A	Phillips Petroleum Co	Phillips Petroleum Co	----do	6	36	5	4
Taloven S.A	Talon Petroleum Co. C.A	Venezuelan investors	Venezuela	3	3	--	--
VISTAVEN C.A	Mito Juan Concesionaria de Hidrocarburos, C.A.	----do	----do	--	2	--	--
Total [1]				333	2,294	984	1,554

[1] Data may not add to totals shown because of independent rounding.

The Mineral Industry of Yugoslavia

By Roman V. Sondermayer [1]

Yugoslavia was among the most prominent producers of nonferrous metals in Europe during 1976. Lignite remained the principal fuel produced in the country. Imports of liquid fuels and high-rank coals were required to meet growing energy demand. The most prominent minerals produced were as follows, with mine production expressed in percentage of world output: Mercury, 6%; magnesite, 5%; lead, 4%; bauxite, 3%; antimony, 3%; copper, 2%; and zinc, 2%. Production of other minerals and fuels remained of only domestic significance.

Based on performance of its major sectors, 1976 was a mixed year for the minerals industry of Yugoslavia. As shown in table 1, changes in output were small and within the normal range of variations for years of recession in Europe. However, a drop in mercury output indicated more serious problems related to conditions in the mercury world market.

The GSP [2] increased 28% to $34 billion [3] in 1976. Unemployment maintained its upward trend and was 13% of the total labor force at yearend 1976 (12% at yearend 1975). Based on monthly data, inflation declined from 20% in the beginning of the year to 10% at yearend, reflecting the result of measures taken by authorities to combat inflation. The minerals industry contributed about 12.4% to the GSP and employed 249,000 persons or 5.1% of the total employment. The following tabulation shows the breakdown of employment and the share of GSP by branch of industry at yearend 1976:

	Employment (thousand)	GSP (percent)
Coal	61	1.6
Petroleum	18	1.8
Nonferrous	58	4.8
Ferrous	59	3.1
Nonmetallics	53	1.1
Total	249	12.4

During 1976, the most significant developments in the minerals industry were construction of alumina plants in Obrovac, Hrvatska (Croatia), and Zvornik, Bosna i Hercegovina (BiH); expansion of aluminum plants at Titograd, Crna Gora (Montenegro), and Šibenik, Croatia; beginning of construction of a copper mill at Bućim, Makedonija (Macedonia); completion of a new steel converter plant in Zenica, BiH; commencement of production at a new antimony mine at Kopaonik, Srbija (Serbia); beginning of platinum and palladium production at Bor, Serbia; development of lignite mines at Tamnava, Ćirkovac, and Drmno; and conclusion of an agreement between The Dow Chemical Co. (Dow) of the United States and Industrija Nafte (INA) of Zagreb, Croatia, for joint investment in a petrochemical complex situated on the island of Krk.

The minerals industry was State owned; however, investment of foreign capital in

[1] Physical scientist, International Data and Analysis.

[2] Gross social product (GSP) is an economic indicator used by Yugoslav authorities instead of gross national product.

[3] Where necessary, values have been converted from Yugoslav dinars (din) to U.S. dollars at a rate of 18 din=US$1.00.

Yugoslavia's minerals industry was allowed providing that Yugoslavia retained ownership of the deposit and controlling interest in the venture.

Mineral output in 1976 and planned targets for 1980 for the new 5-year plan are as follows:

	1976	1980
Coal ---------- million tons	36.8	58.0
Crude oil ---------- do	3.8	4.6
Natural gas ---------- 10^9 cubic meters	1.7	3.0
Bauxite ---------- million tons	2.0	5.1
Alumina ---------- thousand tons	346	1.600
Aluminum ---------- do	198	350
Copper ---------- do	137	180
Lead ---------- do	111	225
Zinc ---------- do	105	155
Nickel ---------- do	--	12
Steel ---------- million tons	2.8	3

In 1976, the railroad line from Bar, on the Montenegro coast, was completed to Belgrade, making accessible remote but mineral-rich areas in Serbia and Montenegro.

PRODUCTION

Higher output with lower use of materials and manpower remained the principal aim in the minerals industry during 1976.

The following tabulation shows output in tons per man-shift for 1970 and 1974 (latest year available):

	Underground		Opencast	
	1970	1974	1970	1974
Bituminous coal	1.3	1.2	--	--
Brown coal	2.1	2.5	6.6	9.9
Lignite	3.8	4.6	11.3	14.2
Iron ore	3.1	4.1	10.5	21.3
Antimony ore	.9	1.0	--	--
Copper ore	9.3	15.4	21.2	45.3
Lead-zinc ore	1.4	1.5	12.9	16.4
Magnesite	1.1	1.1	6.9	5.7
Asbestos	--	--	8.6	6.4
Clays	2.1	2.7	4.6	5.8

Producers of minerals directed their efforts toward modernization and expansion of existing facilities, but the industry remained a mixture of modern and antiquated, with equipment purchased in various countries. However, modern and efficient methods prevailed in petroleum exploration, production, and refining. Dual completion was used at some wells, and secondary recovery at some older fields. Chemical and hydraulic methods for stimulating gas and oil production were everyday practices.

Table 1.—Yugoslavia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
METALS			
Aluminum:			
Bauxite ---thousand tons---	2,370	2,306	2,033
Alumina	272,740	283,090	e 346,000
Metal ingot including secondary	147,089	166,270	197,679
Antimony:			
Mine output, metal content	2,208	2,183	e 1,915
Metal (regulus)	2,349	2,159	2,332
Bismuth, smelter output	100	55	78
Cadmium, smelter output e	240	270	290
Chromium:			
Ore (domestic production)	596	1,694	2,022
Concentrate (produced largely from imported ore)	49,213	38,482	NA
Copper:			
Mine output, metal content	112,116	114,894	136,800
Blister (including secondary)	176,958	162,012	e 160,000
Refined (electrolytic):			
Primary	139,741	123,887	121,587
Secondary	10,265	14,015	14,883
Gold ---troy ounces---	170,302	177,922	e 177,000
Iron and steel:			
Iron ore, gross weight ---thousand tons---	r 5,034	5,239	4,260
Pig iron ---do---	2,126	2,000	1,918
Ferroalloys:			
Ferromanganese	22,626	30,674	200,334
Ferrochrome	38,875	53,902	
Ferrosilicon	104,102	83,168	
Ferrosilicomanganese	17,059	14,409	
Ferrosilicochrome	5,120	10,050	
Other	2,008	2,529	
Crude steel ---thousand tons---	2,836	2,917	2,751
Semimanufactures ---do---	2,235	2,359	2,440
Lead:			
Mine output, metal content	119,826	126,896	e 133,000
Metal:			
Smelter, crude, including secondary	118,428	140,018	e 120,000
Refined including secondary	113,876	126,099	111,220
Manganese ore and concentrate, gross weight	13,282	16,925	19,000
Mercury ---76-pound flasks---	15,838	16,941	12,503
Selenium, elemental ---kilograms---	40,201	43,320	e 45,000
Silver, refined, including secondary ---thousand troy ounces---	4,702	5,412	4,631
Zinc:			
Mine output, metal content	94,682	103,440	e 110,000
Smelter including secondary	86,380	97,605	105,492
NONMETALS			
Asbestos	12,247	12,203	12,830
Barite	50,157	60,645	e 60,000
Cement, hydraulic ---thousand tons---	6,647	7,065	7,633
Clays:			
Crude fire clay	317,658	349,747	e 350,000
Calcined fire clay	82,867	99,198	e 100,000
Feldspar, crude	56,094	54,548	e 55,000
Fertilizer materials, manufactured:			
Gross weight: r [2]			
Nitrogenous ---thousand tons---	869	865	e 940
Phosphatic ---do---	928	764	e 510
Mixed ---do---	199	184	e 180
Nutrient content:			
Nitrogen in nitrogenous and mixed ---do---	r 255	264	277
Phosphorus pentoxide in phosphatic and mixed ---do---	r 181	162	96
Potassium oxide equivalent in mixed	21	19	NA
Gypsum:			
Crude	283,458	449,568	e 450,000
Calcined	89,591	96,159	e 98,000
Lime:			
Quicklime ---thousand tons---	1,333	1,335	1,182
Hydrated ---do---	706	748	e 755
Magnesite:			
Crude	463,510	485,301	391,000
Sintered	269,029	256,588	189,884
Caustic calcined	15,301	5,128	e 5,000
Mica, all grades	r 87	86	e 80
Pyrite concentrate:			
Gross weight	254,741	398,988	440,000
Sulfur content e	107,000	r 168,000	184,000
Quartz, quartzite and glass sand ---thousand tons---	r 1,502	1,605	e 1,650

See footnotes at end of table.

Table 1.—Yugoslavia: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976 [p]
NONMETALS—Continued			
Salt:			
Marine	23,375	37,444	35,000
From brine	202,273	179,530	169,000
Rock	93,081	78,466	85,000
Total	318,729	295,440	289,000
Sand and gravel (except glass sand)--thousand cubic meters	11,797	14,122	NA
Stone (except quartz and quartzite):			
Dimension:			
Crude:			
Ornamental--do	49	46	NA
Other--do	7	1	NA
Partly worked facing--thousand square meters	592	749	779
Cobblestones, curbstones and others-thousand cubic meters	24	35	NA
Crushed and broken, n.e.s--do	7,659	8,277	NA
Milled marble and others, n.e.s--do	3,551	3,990	NA
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	18,576	19,240	e 19,000
Coal:			
Bituminous--thousand tons	601	598	586
Brown--do	9,380	9,429	9,110
Lignite--do	23,601	25,509	27,149
Total--do	33,582	35,536	36,845
Coke:			
Metallurgical--do	1,245	1,263	NA
Breeze--do	78	80	NA
Total--do	1,323	1,343	1,786
Gas:			
Manufactured (city gas only)--million cubic feet	6,848	8,237	NA
Natural, gross production--do	51,100	54,843	61,094
Natural gas plant liquids:			
Natural gasoline and pentane-thousand 42-gallon barrels	129	134	e 147
Propane and butane--do	577	622	e 626
Total--do	706	756	e 773
Petroleum:			
Crude oil:			
As reported--thousand tons	3,458	3,692	3,880
Converted--thousand 42-gallon barrels	25,613	27,347	28,739
Condensate:			
As reported--thousand tons	506	538	NA
Converted--thousand 42-gallon barrels	4,807	5,111	NA
Refinery products:			
Gasoline--do	r 13,821	14,833	16,346
Jet fuel--do	2,418	2,558	2,598
Kerosine--do	99	84	
Distillate fuel oil--do	20,986	22,696	22,149
Residual fuel oil--do	28,751	28,478	31,968
Lubricants--do	1,098	1,184	1,262
Other:			
Liquefied petroleum gas--do	2,234	2,442	e 2,500
White spirit--do	231	217	248
Paraffin--do	66	61	e 65
Asphalt and bitumen--do	2,115	2,339	2,368
Petroleum coke--do	292	282	e 300
Total [3]--do	r 72,111	75,174	79,804

e Estimate. p Preliminary. r Revised. NA Not available.

[1] In addition to the commodities listed, germanium, bentonite, kaolin, common clay, and diatomite are also produced, and tellurium may be recovered as a copper refining byproduct, but available information is inadequate for formulation of reliable estimates of output levels.

[2] As reported in official Yugoslavian production statistics; sum of actual reported gross weight for each class of fertilizer.

[3] Excludes refinery gas (10,403 million cubic feet in 1974, 11,600 million cubic feet in 1975, and an unreported quantity in 1976) as well as other materials produced by and used in the refineries as fuel.

TRADE

During 1976, Yugoslavia remained a net importer of minerals.

Imports of minerals valued at $4.0 billion accounted for 30% of total imports. Fuels, mostly crude oil and bituminous coal, were 43% of the country's mineral imports.

Exports of minerals valued $2.2 billion were 42% of total exports. Products of nonferrous metals were the largest mineral exports of Yugoslavia.

Yugoslavia's mineral trade was diversified. A large number of commodities were traded with a large number of countries, but CMEA[4] and developing countries were the principal partners. Tables 2 and 3 show details of mineral trade.

[4] (CMEA) Council of Mutual Economic Assistance comprising the following countries: Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.

Table 2.—Yugoslavia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite and concentrate -thousand tons--	1,611	1,283	U.S.S.R. 950; Czechoslovakia 143.
Alumina	76,333	73,845	U.S.S.R. 54,639; Czechoslovakia 15,360.
Metal including alloys:			
Scrap	4,935	6,741	Italy 4,819; East Germany 1,638.
Unwrought	69,758	71,964	West Germany 45,638; Czechoslovakia 9,692.
Semimanufactures	45,898	51,695	Czechoslovakia 20,223; Republic of South Africa 18,630; West Germany 6,660.
Antimony regulus	1,774	1,306	U.S.S.R. 1,084.
Bismuth including alloys, all forms	36	33	Republic of South Africa 15; United Kingdom 12.
Cadmium including alloys, all forms	53	65	Republic of South Africa 60.
Chromium:			
Chromite	10,011	3,280	All to Czechoslovakia.
Oxide and hydroxide	NA	193	All to East Germany.
Copper:			
Matte	NA	NA	
Copper sulfate	4,260	5,790	Bulgaria 2,000; People's Republic of China 1,575; Greece 1,255.
Metal including alloys:			
Scrap	43	154	Mainly to Italy.
Unwrought	72,235	47,139	Republic of South Africa 21,922; United Kingdom 11,478; Italy 7,555.
Semimanufactures	31,482	33,856	U.S.S.R. 8,756; Iraq 5,191; Czechoslovakia 4,222.
Iron and steel:			
Ore and concentrate	141	30,000	All to Czechoslovakia.
Roasted pyrite	909	5,998	All to Hungary.
Metal:			
Scrap	1,082	21,637	Italy 15,834; East Germany 5,021.
Pig iron, ferroalloys, similar materials	459,187	171,613	Italy 72,567; Romania 37,640; Republic of South Africa 20,058.
Steel, primary forms	21,986	8,881	Hungary 4,997; Italy 2,676; Poland 1,000.
Semimanufactures:			
Bar, rods, angles, shapes, sections	260,400	66,489	U.S.S.R. 22,560; Romania 8,663; Czechoslovakia 6,951.
Universals, plates, sheets	145,800	51,299	U.S.S.R. 26,139; Poland 16,391.
Hoop and strip	3,453	1,649	Italy 1,571.
Rails and accessories	54,232	45,395	Romania 43,037.
Wire	3,391	738	West Germany 460; Hungary 194.
Tubes, pipes, fittings	151,358	170,328	U.S.S.R. 84,102; West Germany 24,500; Austria 21,170.
Castings and forgings	17,806	14,059	Poland 4,814; Czechoslovakia 2,384; West Germany 1,528.

See footnote at end of table.

Table 2.—Yugoslavia: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Lead:			
Ore and concentrate	23,289	368	All to East Germany.
Oxides	NA	7	West Germany 4; Central Africa 1; U.S.S.R. 1.
Metal including alloys:			
Unwrought	44,834	66,253	U.S.S.R. 18,897; Republic of South Africa 10,370; Austria 8,904; Czechoslovakia 7,478.
Semimanufactures	1,697	455	Italy 233; France 110; Saudi Arabia 70.
Manganese:			
Ore and concentrate	4,818	5,415	Italy 5,385.
Oxides	NA	NA	
Mercury, 76-pound flasks	9,486	8,412	All to Republic of South Africa.
Nickel including alloys, all forms	269	267	Do.
Platinum-group metals including alloys, all forms, palladium, troy ounces	2,861	4,501	East Germany 3,858; Republic of South Africa 643.
Selenium, elemental, kilograms	34,700	NA	
Silicon	20,486	16,507	U.S.S.R. 11,641; Romania 1,849.
Silver metal including alloys, all forms, thousand troy ounces	3,581	3,694	Republic of South Africa 3,192; Czechoslovakia 474.
Tin including alloys, all forms	69	50	Austria 25; Italy 25.
Titanium oxides	8,887	13,547	West Germany 13,239.
Uranium ore and concentrate	2,043	2,015	Hungary 2,007.
Zinc:			
Ore and concentrate	1,410	7,698	Italy 7,652.
Oxide	210	37	All to Albania.
Metal including alloys:			
Blue powder	1,948	3,233	Czechoslovakia 2,903.
Unwrought	40,697	51,208	Czechoslovakia 20,166; Republic of South Africa 11,983; United Kingdom 6,559.
Semimanufactures	8,180	7,351	East Germany 3,232; Czechoslovakia 2,671; Hungary 840.
Other:			
Ash and residue of nonferrous metals	1,226	22,924	Bulgaria 17,403; Italy 2,815.
Oxides, hydroxides, and peroxides of metals, n.e.s	45	47	Netherlands 37.
NONMETALS			
Abrasives, natural, n.e.s., grinding and polishing wheels and stones	2,364	2,660	Poland 1,356; Romania 484.
Asbestos	1,735	3,259	East Germany 1,139; Albania 846; United Kingdom 483; East Germany 449.
Barite and witherite	40,830	47,732	U.S.S.R. 35,529; Hungary 12,203.
Cement	234,692	431,205	Nigeria 125,130; Libya 74,920.
Chalk	38	14	All to U.S.S.R.
Clays and clay products (including all refractory brick):			
Crude clays, n.e.s.:			
Bentonite	11,259	848	Poland 638; Libya 200.
Fire clay	18,343	5,212	Hungary 2,992; Italy 2,200.
Kaolin	724	4,765	Italy 4,757.
Products:			
Refractory (including nonclay brick)	109,779	149,952	U.S.S.R. 59,895; Poland 25,129; Romania 20,553; East Germany 17,832.
Nonrefractory	1,649	635	U.S.S.R. 258; Libya 123; Czechoslovakia 72.
Diatomite and other infusorial earth	11	NA	
Feldspar	17,448	12	All to Czechoslovakia.
Fertilizer materials, manufactured:			
Nitrogenous	6,250	5,521	East Germany 3,000; West Germany 2,521.
Phosphatic	239,806	16,744	Hungary 12,723; Bulgaria 1,489.
Other including mixed	387,471	157,219	North Korea 63,031; Hungary 52,197; Ghana 15,011.
Gypsum and plasters	NA	18	Czechoslovakia 10; U.S.S.R. 8.
Lime	NA	743	Hungary 703.
Magnesite	70,874	69,599	U.S.S.R. 25,056; Poland 12,422; Republic of South Africa 11,161; Italy 10,297.
Pyrite (gross weight)	24,327	171,920	Romania 123,320; East Germany 48,600.

See footnote at end of table.

Table 2.—Yugoslavia: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Salt and brine	NA	51	Hungary 50; Guinea 1.
Sodium and potassium compounds, n.e.s	22,305	16,071	U.S.S.R. 8,928; Italy 5,777.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	58,319	61,400	Italy 30,537; Czechoslovakia 19,691.
Worked	11,151	10,450	East Germany 6,420; Austria 2,712; Czechoslovakia 1,084.
Dolomite, chiefly refractory grade	60	196	Libya 106; Greece 90.
Gravel and crushed rock	194	1,902	West Germany 560; Italy 320; Romania 292; United Kingdom 212.
Limestone (except dimension)	307	146	All to Hungary.
Quartz and quartzite	23,276	21,049	All to East Germany.
Sand, excluding metal bearing	3,404	2,198	Greece 1,972.
Sulfur:			
Elemental other than colloidal	6,018	NA	
Sulfur dioxide	NA	5	All to Czechoslovakia.
Sulfuric acid	25,599	19,819	Czechoslovakia 11,802; Albania 4,268; Romania 2,582.
Talc, steatite, soapstone, pyrophyllite	NA	22	All to Albania.
Other:			
Crude:			
Calcite	100	NA	
Unspecified	71	1,071	All to Greece.
Slag, dross and similar waste, not metal bearing	5,943	5,044	Italy 2,955; Austria 1,390; Albania 699.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	2,391	503	Mainly to Czechoslovakia.
Coal and briquets:			
Anthracite and bituminous coal	NA	10,149	All to Austria.
Lignite and lignite briquets	444,663	339,068	Italy 37,887; Austria 35,407.
Hydrogen, helium and rare gases—kilograms	219	100	All to Czechoslovakia.
Peat, including peat briquets and litter	418	22	All to Italy.
Petroleum:			
Crude and partly refined:			
Crude—thousand 42-gallon barrels	341	NA	
Partly refined—do	NA	28	All to Austria.
Refinery products:			
Gasoline—do	79	44	Austria 6; Italy 4.
Kerosine and jet fuel—do	293	288	United Kingdom 71; U.S.S.R. 31; France 31.
Distillate fuel oil—do	69	604	Italy 164; Switzerland 157; East Germany 90.
Residual fuel oil—do	107	396	Austria 102; Israel 66.
Lubricants—do	55	1	NA.
Other:			
Liquefied petroleum gas—do	12	104	All to Italy.
White spirit—do	509	4	All to Austria.
Mineral jelly and wax—do	33	NA	
Petroleum coke—do	47	5	All to Austria.
Unspecified—do	1,249	1	All to Libya.
Total—do	2,453	1,142	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	13,943	820	Italy 790.

NA Not available.

Table 3.—Yugoslavia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate --thousand tons--	219	109	Australia 67; Greece 29.
Alumina	NA	523	Guinea 408; Republic of South Africa 81.
Oxide and hydroxide	66,876	174,490	Guinea 104,650; Republic of South Africa 63,190.
Metal including alloys:			
Unwrought	48,931	32,331	U.S.S.R. 24,423; Bulgaria 4,037.
Semimanufactures	23,092	16,227	East Germany 4,595; U.S.S.R. 4,269.
Antimony:			
Ore and concentrate	2,862	3,276	Morocco 1,335; Thailand 1,054; Turkey 553.
Metal including alloys, all forms	40	127	France 40; People's Republic of China 30; Belgium-Luxembourg 30; Italy 20.
Arsenic:			
Trioxide, pentoxide and acids	54	49	All from East Germany.
Metal including alloys, all forms	17	25	Sweden 18; U.S.S.R. 5; East Germany 2.
Beryllium including alloys, all forms kilograms--	201	121	All from East Germany.
Bismuth including alloys, all forms	24	4	Do.
Cadmium including alloys, all forms	6	4	East Germany 2; Italy 1.
Chromium:			
Chromite	176,463	224,809	Albania 102,867; U.S.S.R. 58,847.
Oxide and hydroxide	120	535	U.S.S.R. 450; Hungary 70.
Metal including alloys, all forms	17	14	United Kingdom 8; France 5; East Germany 1.
Cobalt:			
Oxide and hydroxide	34	19	Belgium-Luxembourg 10; France 4; East Germany 3.
Metal including alloys, all forms	42	41	Belgium-Luxembourg 34.
Columbium and tantalum, tantalum including alloys, all forms kilograms--	423	590	Republic of South Africa 232; Austria 112; Netherlands 92; Hungary 80.
Copper:			
Ore and concentrate	78,456	9,991	All from United Kingdom.
Copper sulfate	755	685	Mainly from U.S.S.R.
Metal including alloys:			
Scrap	57	NA	
Unwrought	29,366	37,541	Chile 17,139; Zambia 16,877.
Semimanufactures	6,338	7,744	Chile 2,644; East Germany 2,533.
Germanium including alloys, all forms kilograms--	54	71	Mainly from Poland.
Iron and steel:			
Ore and concentrate	430,528	597,924	Brazil 339,838; U.S.S.R. 258,086.
Metal:			
Scrap	427,780	346,398	U.S.S.R. 179,382; Bulgaria 48,104.
Pig iron including cast iron	62,325	95,217	India 32,829; U.S.S.R. 26,609; Czechoslovakia 18,431; North Korea 10,499.
Sponge iron, powder, and shot	2,239	9,293	France 2,956; Sweden 1,973.
Ferroalloys:			
Manganese	2,761	1,801	East Germany 1,424; Norway 198.
Other	4,778	5,785	East Germany 2,555; France 1,417; Austria 756.
Steel, primary forms:			
Blooms, billets, slabs, sheet bars	258,503	393,697	U.S.S.R. 176,193; Czechoslovakia 83,081; West Germany 46,726.
Coils for recoiling	247,546	478,273	Czechoslovakia 100,184; U.S.S.R. 94,230; Japan 82,128; Greece 48,805.
Semimanufactures:			
Bars, rods, angles, shapes, sections	289,576	513,674	Czechoslovakia 102,008; Poland 98,417; Romania 50,369.
Universals, plates, sheets	686,586	495,795	Japan 119,310; East Germany 110,603; Czechoslovakia 62,435; Italy 53,353; Greece 46,992.
Hoop and strip	78,704	137,836	Poland 38,946; East Germany 30,779; Czechoslovakia 13,310.

See footnote at end of table.

Table 3.—Yugoslavia: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Iron and steel—Continued			
Metal—Continued			
Semimanufactures—Continued			
Rails and accessories	5,485	16,516	Austria 11,469; U.S.S.R. 2,476; East Germany 2,376.
Wire	45,188	81,144	Romania 21,118; Poland 18,664; East Germany 13,216.
Tubes, pipes, fittings	71,697	103,441	East Germany 35,127; Italy 23,716; West Germany 21,871.
Castings and forgings, rough	1,073	1,225	East Germany 661; Italy 142.
Lead:			
Ore and concentrate	6,232	20,106	Republic of South Africa 9,440; Greece 7,528.
Oxides	895	924	East Germany 385; Austria 366; Bulgaria 104.
Metal including alloys:			
Scrap	2,088	3,130	Nigeria 949; Switzerland 734; Liberia 672.
Unwrought	18,907	15,800	Bulgaria 6,143; North Korea 5,004; Zambia 4,350.
Semimanufactures	44	36	All from East Germany.
Magnesium metal including alloys, all forms	1,043	825	U.S.S.R. 226; Italy 135; East Germany 133; Republic of South Africa 111; France 105; Norway 99.
Manganese:			
Ore and concentrate	74,176	77,610	Gabon 29,346; U.S.S.R. 28,928; Republic of South Africa 12,931.
Oxides	2,950	1,408	Gabon 800; Republic of South Africa 250.
Metal	321	353	Japan 163; East Germany 146; Netherlands 40.
Mercury 76-pound flasks	319	1,682	All from Canada.
Molybdenum metal including alloys, all forms	15	16	Austria 10; United Kingdom 3; Netherlands 1.
Nickel metal including alloys, all forms:			
Scrap	NA	3	All from United Kingdom.
Matte, speiss, and similar materials	22	NA	
Unwrought	1,031	170	East Germany 83; Sweden 35.
Semimanufactures	705	635	East Germany 546.
Platinum-group metals including alloys, all forms:			
Platinum troy ounces	4,372	1,511	Mainly from Italy.
Palladium do	38,291	30,896	U.S.S.R. 28,807.
Rhodium do	32	32	All from East Germany.
Other do	1,446	1,961	East Germany 965; United Kingdom 965.
Silver metal including alloys thousand troy ounces	2,022	1,789	Switzerland 694; Austria 385.
Tellurium, elemental kilograms	25,845	316	East Germany 301.
Tin:			
Oxides	12	6	East Germany 5.
Metal including alloys:			
Unwrought	1,612	1,038	Malaysia 669; People's Republic of China 300.
Semimanufactures	31	20	Mainly from East Germany.
Titanium:			
Ore and concentrate	36,757	52,069	Australia 51,747.
Oxides	4,199	2,932	East Germany 1,173; France 981; Czechoslovakia 305.
Metal including alloys, all forms	12	113	U.S.S.R. 100.
Tungsten metal including alloys, all forms	12	9	France 3; Netherlands 2; Austria 1; United Kingdom 1.
Zinc:			
Ore and concentrate	68,318	58,046	North Korea 13,558; Mexico 9,737; Peru 9,526; Japan 8,335; Canada 7,262; Greece 6,135.
Oxide	158	166	East Germany 151.
Metal including alloys:			
Unwrought	26,010	18,772	Zambia 14,970; Bulgaria 2,739.
Semimanufactures	679	298	East Germany 279.
Zirconium including alloys, all forms	30	4	East Germany 3.
Other:			
Ore and concentrate:			
Of vanadium, tantalum, zirconium	246	363	Australia 178; East Germany 165.

See footnote at end of table.

Table 3.—Yugoslavia: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Other—Continued			
Ore and concentrate—Continued			
Of base metals, n.e.s	NA	3,276	Morocco 1,335; Thailand 1,054; Turkey 553.
Ash and residue containing nonferrous metals	606	55	Austria 20.
Oxides, hydroxides and peroxides of metals, n.e.s	726	707	East Germany 484.
Metals including alloys, all forms:			
Metalloids	NA	186	East Germany 101; France 48; U.S.S.R. 25.
Alkali, alkaline earth, and rare-earth metals	240	291	France 176; East Germany 60; Italy 42.
Pyrophoric alloys	3	10	East Germany 4; Austria 2; Italy 1; United Kingdom 1.
Base metals including alloys, all forms, n.e.s	NA	35	Italy 25; Belgium-Luxembourg 5; East Germany 5.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	319	229	Denmark 115; Italy 85.
Grinding and polishing wheels and stones	2,152	1,634	Austria 944; East Germany 230; Italy 187.
Asbestos	54,296	52,138	U.S.S.R. 34,257; Botswana 9,338.
Barite and witherite	1,363	1,393	East Germany 1,080; Czechoslovakia 170.
Boron materials:			
Crude natural borates	12,626	20,057	Republic of South Africa 12,822; Turkey 6,950.
Oxides and acid	1,466	1,519	U.S.S.R. 420; East Germany 318; Netherlands 194; France 165; Austria 156.
Bromine	6	6	All from Austria.
Cement:			
Portland—thousand tons	840	529	Romania 316; France 129.
Other—do	162	139	Italy 129.
Chalk	1,082	2,388	France 1,605; Austria 676.
Clays and clay products (including all refractory brick):			
Crude clays n.e.s.:			
Bentonite	1,444	424	Greece 319; United Kingdom 59.
Fire clay	18,591	18,212	Czechoslovakia 16,547.
Fuller's earth, dinas, chamotte	3,379	2,830	Italy 1,666; Czechoslovakia 532.
Kaolin	48,332	59,528	Czechoslovakia 29,170; West Germany 13,207; Greece 9,571.
Other	5,689	4,496	Czechoslovakia 3,360.
Products:			
Refractory (including nonclay bricks)	29,772	27,960	East Germany 14,288; Austria 7,009; Italy 3,962.
Nonrefractory	315,669	68,260	Albania 16,430; Romania 13,834; Italy 9,256; Czechoslovakia 8,097; Bulgaria 7,588.
Cryolite and chiolite	750	360	Denmark 288; East Germany 72.
Diamond:			
Gem, not set or strung—carats	NA	15,000	Belgium-Luxembourg 10,000.
Industrial—do	NA	65,000	Switzerland 30,000; United Kingdom 25,000.
Powder—do	NA	70,000	U.S.S.R. 40,000; United Kingdom 20,000.
Diatomite and other infusorial earth	109	148	Austria 93; Italy 25; Sweden 20.
Feldspar	81	1,070	France 800; East Germany 115.
Fertilizer materials:			
Crude, phosphatic—thousand tons	1,199	846	Morocco 730.
Manufactured:			
Nitrogenous	167,021	157,585	Czechoslovakia 50,593; U.S.S.R. 41,171; Romania 38,079.
Phosphatic	20,966	43,927	Tunisia 17,000; Ireland 11,000; Bulgaria 10,101.
Potassic	383,421	247,385	West Germany 142,289; U.S.S.R. 95,447.
Other including mixed	4,519	14,419	Poland 14,244.
Ammonia	45,594	39,276	Hungary 30,508; Austria 4,471.

See footnote at end of table.

Table 3.—Yugoslavia: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Fluorspar	5,708	6,638	West Germany 3,643; East Germany 2,106.
Graphite, natural	1,867	1,569	Austria 1,036; West Germany 200; East Germany 188.
Gypsum and plasters	4,698	7,712	Poland 7,703.
Iodine	33	50	Japan 30; East Germany 11; Poland 8.
Lime	11,395	476	Mainly from Bulgaria.
Magnesite	3,921	12,221	Turkey 10,009; Republic of South Africa 2,007.
Mica:			
Crude, including splittings and waste	266	396	Norway 218; East Germany 120.
Worked, including agglomerated splittings	167	323	United Kingdom 192.
Pigments, mineral:			
Natural, crude	5	7	All from Austria.
Iron oxides, processed	4,199	2,932	East Germany 1,173; France 981; Czechoslovakia 305.
Precious and semiprecious stones, except diamond:			
Natural kilograms	68	29	East Germany 27.
Manufactured do	267	410	Switzerland 266; East Germany 98.
Pyrite (gross weight)	231,452	101,310	U.S.S.R. 101,209.
Quartz, piezoelectric kilograms	1,214	564	France 500.
Salt and brine	128,603	113,247	Romania 79,425; Tunisia 33,000.
Sodium and potassium compounds, n.e.s.:			
Caustic soda	101,856	115,922	Italy 39,439; East Germany 34,160; France 33,573.
Caustic potash, sodic and potassic peroxides	1,809	2,006	West Germany 984; Italy 414; Czechoslovakia 313; East Germany 284.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked:			
Calcareous	4,548	4,208	Italy 2,428; Greece 1,723.
Slate	402	326	East Germany 323.
Other	2,887	2,480	All from Italy.
Worked:			
Slate	51	37	Do.
Other	68	25	Italy 10; East Germany 7; Sweden 7.
Dolomite, chiefly refractory grade	5,499	4,409	Italy 3,446; Austria 874.
Gravel and crushed rock	124,993	143,371	Hungary 137,963.
Limestone (except dimension)	18,405	40,202	Hungary 40,167.
Quartz and quartzite	12,359	16,031	Greece 8,861; East Germany 5,763.
Sand excluding metal bearing	96,931	101,932	Italy 71,120; East Germany 8,811.
Sulfur:			
Elemental, all forms	47,760	1,832	Italy 1,606.
Sulfur dioxide	33	80	Mainly from Italy.
Sulfuric acid	104,123	155,110	Hungary 38,073; Netherlands 29,245; East Germany 17,148; West Germany 16,835.
Talc, steatite, soapstone, pyrophyllite	3,027	2,488	Italy 739; France 672; Austria 519.
Other nonmetals, n.e.s.:			
Crude	10,131	10,947	Hungary 9,291; Austria 1,259.
Slag, dross, and similar waste, not metal bearing	246,007	298,762	Italy 269,261; Hungary 21,454.
Oxides and hydroxides of magnesium, strontium, and barium	407	506	East Germany 197; France 186; Republic of South Africa 100.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,398	3,686	Albania 2,029; Hungary 1,190.
Carbon black and gas carbon	6,972	7,976	Italy 6,431; East Germany 982.
Coal and briquets:			
Anthracite and bituminous coal thousand tons	1,946	2,176	U.S.S.R. 1,433; Czechoslovakia 615.
Briquets of anthracite and bituminous coal	29,630	NA	
Lignite and lignite briquets	67,587	155,855	U.S.S.R. 89,517; Hungary 66,337.

See footnote at end of table.

Table 3.—Yugoslavia: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Coke and semicoke ----------thousand tons--	607	499	Poland 276; U.S.S.R. 92; Italy 17.
Hydrogen, helium, rare gases ----kilograms--	77,044	24,147	Austria 9,406; Italy 7,784.
Peat, including peat briquets and litter ------	7,212	8,114	Hungary 1,455.
Petroleum:			
Crude -------thousand 42-gallon barrels--	51,842	51,779	Iraq 31,234; U.S.S.R. 12,614.
Partly refined ----------do----	112	126	East Germany 49; Italy 35; Bulgaria 35.
Refinery products:			
Gasoline ----------do----	419	94	Italy 60; United Kingdom 17; Italy 9.
Kerosine and jet fuel ----------do----	112	2	Netherlands 1.
Distillate fuel oil ----------do----	373	3,088	U.S.S.R. 2,581.
Residual fuel oil ----------do----	7,013	2,171	U.S.S.R. 1,792; Romania 273.
Lubricants ----------do----	273	147	East Germany 33; Italy 14; Austria 13.
Other:			
Liquefied petroleum gas ---do----	209	3	Mainly from Czechoslovakia.
Mineral jelly and wax ----do----	43	5	West Germany 1; Hungary 1; Romania 1; East Germany 1.
Nonlubricating oils, n.e.s --do----	70	119	Bulgaria 42; U.S.S.R. 28; Italy 14; Hungary 14.
Bitumen and other residues, n.e.s do----	2,018	303	Albania 248; Czechoslovakia 30.
Bituminous mixtures, n.e.s--do----	35	18	Italy 12.
Pitch ----------do----	91	88	East Germany 44; Italy 33; France 11.
Petroleum and pitch coke --do----	1,001	484	Republic of South Africa 253; U.S.S.R. 182.
Unspecified ----------do----	34	NA	
Total ----------do----	11,691	6,522	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals ----------	13,159	58,975	Italy 14,846; Romania 14,035; U.S.S.R. 13,466.

NA Not available.

COMMODITY REVIEW

METALS

Aluminum.—Development of new bauxite mines and construction of alumina and aluminum plants continued during 1976. The aim was to convert Yugoslavia's aluminum industry from a producer and exporter of bauxite to a processor of bauxite and exporter of alumina and aluminum metal.

Activities related to bauxite were limited to exploration in the areas near existing mines and to expansion by 0.5 million tons each of mines near Vlasenica, BiH, and Nikšić, Montenegro. New capacity at Vlasenica was necessary to assure future supply of bauxite to the new alumina plant at Zvornik, BiH, and additional bauxite from Nikšić will be necessary to meet future higher demand for the expanded Titograd Alumina Plant. Bauxite was produced along the Adriatic Sea in Croatia (Obervac), and inland in Montenegro (Nikšić) and BiH (Mostar and Vlasenica). In Serbia, bauxite was produced at Kosovo, near Priština. Energoinvest, with its mines in BiH, was the largest producer of bauxite in the country. The largest mine complex operated by Energoinvest was the Vlasenica group of mines. Yugoslavia was more than self-sufficient in bauxite and exported about 40% of its output.

Financed with credits from the U.S.S.R., construction of a 600,000-ton-per-year alumina plant at Zvornik, BiH, continued. Plans called for completion of one-half of capacity in June 1977 and of the rest in December of the same year.

Near Obrovac, construction continued on a 300,000-ton-per-year alumina plant. The plant was partly financed with loans from East Germany and Hungary. Startup was planned for 1977.

The alumina plant at Titograd, Montenegro, was the largest producer of alumina in the country contributing 54% to the total output. During the winter of 1975–76, construction started on doubling capacity at the Titograd Aluminum Plant. When completed, the plant should have an annual capacity of 100,000 tons of aluminum, 280,000 tons of alumina, and 50,000 tons of carbon anodes.

At the Šibenik aluminum plant, plans were made public to add 104 cells with an annual capacity of 35,000 tons to the existing installation. In addition, the management of the Šibenik plant announced a decision to build a secondary aluminum smelter with a capacity of 15,000 tons per year of secondary aluminum. Completion was planned for 1978. With a capacity of 75,000 tons per year, the Šibenik plant remained the largest producer of aluminum metal in the country.

Antimony.—After several years of exploration, trial production of antimony ore and concentrate started at a mine situated in Rajićeva Gora, Kopaonik, Serbia. Exploration and mine and mill construction were financed by Rudarsko Topionički Bazen Zajača (RTB-Zajača), Serbia. Production at an annual rate of 45,000 tons was to increase to 300,000 tons by 1979. Reserves in the area were between 10 million and 15 million tons. Grade of ore was not made public. The new mine is significant because if successful, imports of antimony concentrate would not be necessary in the future. RTB-Zajača, with its smelter near Zajača, Serbia, produced all the antimony metal in the country.

Copper.—Exploration at Veliki Krivelj, Serbia, beginning of mine and mill construction at Bućim, Macedonia, and startup of a copper alloy foundry at Bor, Serbia, were the major activities related to copper.

In Serbia, exploration of the Veliki Krivelj deposit was intensified, and in addition small deposits were located near Prijepolje and Kosjerić, which were low grade (1% copper) and inaccessible making production questionable.

Construction started on a mill at the Bućim copper mine in Macedonia. The mill was rated at 3.7 million tons of ore per year. Plans call for an output of 100,000 tons of copper concentrate (lower limit, 22% copper). In addition, the concentrate contains about 26 grams of silver and 1.5 grams of gold per ton. Tentatively, startup at Bućim was scheduled for 1978. Bućim, when operational, will be the first producer of copper ore and concentrate in Yugoslavia outside the Bor copper region. At Bor, a new 81,000-ton-per-year copper alloy foundry will reach its designed capacity late in 1978 or early in 1979.

The management of Bor announced a decision to build another sulfuric acid plant at the Bor copper smelter. Capacity of the plant was reported at 230,000 tons of sulfuric acid per year. Completion was scheduled for 1978.

Rudarsko Topionički Bazen Bor (RTB-Bor) was the largest producer of copper ore, concentrates, and metal in the country. RTB-Bor operated mines, a concentrator, a smelter, and an electrolytic plant at Bor, Serbia, and a mine and concentrator at Majdanpek, Serbia. The operations are about 50 kilometers apart. Concentrate from Majdanpek was smelted at Bor. Domestic output of ore and concentrate met about 95% of the country's demand in 1976.

Iron and Steel.—During 1976, efforts continued to develop additional facilities for increased production of iron ore, pig iron, and steel in Yugoslavia.

Exploration for iron ore was conducted in various parts of the country. The most promising results were in Bosnia (Vareš, Ljubija) and the western part of Macedonia. The following tabulation shows the status of iron ore reserves in Yugoslavia by region at the beginning of 1976, in million tons:

Region	Proven reserves	Total resources
Ljubija	465	1,200
Vareš, Bosnia	269	600
Vakuf-Jablanica, Bosnia	15	50
West Macedonia	114	300
Total Dinaric Province	863	2,150
Region Borjane	3.5	6.5
Region Kopaonik	3.9	8.9
Region Preševo-Prokuplje	5.5	6.5
Damjan	18.3	33.3
Pehceva	16.5	26.5
Total Serbian-Macedonia Region	47.7	81.7
Region of East Serbia	6.9	9.9

Iron content of Yugoslav ore varies between 20% and 46%, and the average was reported to be 30%. During 1976, the number of iron ore producing facilities remained the same as in 1975, and the output remained at the same order of magnitude as in the previous year. Iron ore was mined at four mines and upgraded at four concentrators, one pelletizing plant, and seven agglomeration (sintering) installations. Iron mines at Vareš and Ljubija, in Bosnia, operated by Rudarsko-Metalurški-Kombinat-Zenica (RMK-Zenica), remained the largest producers of iron ore in the country, accounting for about 76% of the total iron ore output of Yugoslavia. Production of domestic iron ore supplied about 90% of the country's demand. In the Vareš mine, new sections, when completed in 1978, should bring mine output to 2.4 million tons, about 600,000 tons more than in 1975.

During 1976, pig iron was produced at seven plants and steel at eight plants. Seven rolling mills were in production during 1976.

The RMK-Zenica remained the major producer of steel in the country with a 34% share in the total. At RMK-Zenica, a new oxygen-converter steel plant started trial production. Two converters, each with a capacity of 150 tons of steel per hour or about 1.3 million tons of steel per year, were commissioned in August 1976. In December 1976, a cold rolling mill (annual capacity 150,000 tons of rolled products) went onstream. Both additions, steel plant and rolling mill, were part of the continuous effort by Yugoslav authorities to increase domestic output and reduce imports of steel products. Domestic steel output met 70% of country's demand.

Lead and Zinc.—Smelter production capacity was in excess of mine production during 1976. Exploration for new lead-zinc deposits, commissioning of a new mine, and expansion of existing mines and mills started in the early 1970's were the essential parts of a program aimed at closing the gap.

The new Tisovik mine near Pecka, Serbia, started trial production in December 1976. Output of the mine was planned at 6,000 tons of ore per year.[5]

After 7 years of development work, the Brskovo mine near Mojkovac, Montenegro, shipped its first zinc concentrate to the zinc electrolytic plant at Šabac. The mine was rated at 500,000 tons of ore per year.

Expansion continued at mines and mills at Trepča Lece, Blagodat, Novo Brdo. When all work is completed, an additional aggregated output of 24,000 tons of lead and zinc is expected. Work in Trepča's Stari Trg mine near Kosovska Mitrovica, Serbia, was concentrated on development of levels 10 and 11 at a depth of 750 meters. Large quantities of water under pressure of 200 pounds per square inch (psi) slowed down work on both levels. Production from levels 10 and 11 is scheduled to bring output of Stari Trg mine to 1 million tons of lead-zinc ore per year.

In addition to mine expansion, the management of Trepča decided to award a contract for expansion to 70,000 tons per year by 1978 of the zinc plant at Kosovska Mitrovica to Dowa Mining and Arita Zinc Co., Ltd., of Japan. The contract value of $30 million will be paid in two installments. The first half will be made as a down payment and the balance 5 to 6 years after startup.

After several years of less than successful trials, the Trepča sulfuric acid plant started production. Output of 94,000 tons of sulfuric acid per year may be expected

[5] Yugoslav Economic Daily. Privredni Pregled-Beograd, June 18, 1976, p. 3.

if the plant continues to operate without difficulties.

During 1976 about 18 mines and 14 flotation plants were operational. Two lead smelters (Trepča-Zvečan and Mežica), and one lead refinery (Trepča-Zvečan) produced lead. In addition, one Imperial smelting plant (Titov Veles) produced lead and zinc and two zinc electrolytic plants (Šabac and Kosovska Mitrovica) produced zinc.

RMK Trepča was the largest lead-zinc producer in the country. Among other facilities, Trepča operated the largest lead and zinc mine, Stari Trg, the largest lead smelter and refinery, Trepča-Zvečan, and zinc electrolytic plant at Kosovska Mitrovica.

Nickel.—During 1976, development of a mine and construction of a ferronickel plant continued at Ržanovo near Kavadarci in Macedonia. Production of 16,000 tons of contained nickel was scheduled for 1978. Proven reserves of 24 million tons averaging 0.9% nickel were reported. Yugoslavia's Feni-Rudnici i Industrija za Nikel, Čelik i Antimon-Kavadarci, will be the operator.

Platinum and Palladium.—Yugoslavia became a producer of platinum and palladium in the fall of 1976. Platinum and palladium were recovered at RTB-Bor from sludge from the copper electrolytic plant. Output was planned at about 15 to 34 kilograms of platinum and about 100 kilograms of palladium.

Uranium.—Construction, by Westinghouse, of the first Yugoslav nuclear powerplant, Krsko (615 megawatts electrical), continued near the town of Krsko in Slovenia. Some delays in deliveries of equipment have pushed back the completion date. Work and development on the Žirovski Vrk uranium mine and yellow cake plant reportedly went according to plans.

Other Metals.—Yugoslavia also produced bismuth, cadmium, chromite, germanium, gold, manganese, mercury, selenium, and silver in 1976. Except for mercury, produced at Idria, Slovenia, output of the other metals was modest. It should be noted that economic difficulties (low mercury prices) may force closing of the Idria mercury mine during 1977. Bismuth was a byproduct of the lead and zinc operation at Trepča; and cadmium was a byproduct at Trepča and at the Zorka plant at Šabac, Serbia. The Bor complex yielded gold, germanium, and selenium as byproducts of copper. Manganese was produced in Bosnia. Trepča was the main source of silver, a byproduct of lead and zinc processing.

NONMETALS

Cement.—Output of cement ranked first in value of nonmetals produced in the country, and reached an all-time high of 7.6 million tons.

Construction of a new cement plant at Popovac, Serbia, was announced. The plant will have a capacity of 900,000 tons of cement. F. L. Smidth of Denmark was the main contractor, and completion was set for 1979. Construction continued on a 600,000-ton-per-year cement plant near Našice, Croatia, and on a 720,000-ton-per-year cement plant near Kakanj. Dalmacija Cement, with its plants at Solin near Split, was the largest producer of cement accounting for 30% of total cement output of Yugoslavia in 1976.

Clays.—*Bentonite.*—New reserves totaling 100 million tons of bentonite, situated in Slaviško Poje near Kriva Palanka, permitted the Bentomak mine to start construction of a facility for production of 40,000 tons of alkali-activated bentonite. At yearend, a new plant was near completion, and startup was announced for 1977.

A bentonite deposit was discovered at Gušica near Vitina in the Kosovo region. Reserves were reported at 73 million tons. Authorities have organized an enterprise, Bentokos, to start production of about 100,000 tons of bentonite per year.

Fertilizer Materials.—*Phosphate Rock.*—A feasibility study for development of the first phosphate mine, Lisina near Bosiljgrad, Serbia, was underway during 1976. Reserves were estimated at 100 million tons and RTB-Bor financed exploration. The study proposed an annual production of 3.6 million tons of crude ore, with an output of 900,000 tons of concentrates. Fertilizer factories at Prahovo, Šabac, and Kosovska Mitrovica, all in Serbia, would be users of concentrates from Lisina.

Lime.—During 1976 the following new lime plants went onstream: Čelinac (65,000 tons per year) and Doboj (280,000 tons per year), both in Bosnia. Construction continued on a 100,000-ton-per-year lime plant at Drniš, Croatia.

MINERAL FUELS

Energy.—During 1976, domestic low-rank coals remained the principal source of energy in the country, and Yugoslavia was dependent on imports of high-rank coals, coke, and crude oil. Table 4 shows supply and apparent consumption of energy-producing materials for 1974 and 1975.

Coal.—During 1976, about 49 coal mines were in operation in the country. However, approximately 60% of output came from four large coal operations (Kosovo, Kolubara, Kostolac, and Kreka). Brown coal and lignite comprised the bulk (98%) of Yugoslavia's coal output. Imports of bituminous coal and coke were essential for the energy supply of the country. Imports of coking coal will, in the future, increase to meet the demand of the new coking facilities scheduled for completion in 1978.

A new $19 million opencast brown coal mine, Turija, started production near Banovići in Bosnia. The mine, with an initial capacity of 1.3 million tons per year, was slated for an output of 2 million tons in 1980 and 5 million tons in 1990.

Development of the new Tamnava mine in the Kolubara Basin, Serbia, continued. When completed in 1980, the Tamnava mine will produce between 18 million and 20 million tons of lignite per year, and all mines in the Kolubara Basin will together produce 24 million tons annually.

In the Kostolac Basin, Serbia, development of a new 2.5-million-ton opencast mine, Ćirkovac, was near completion at yearend. Development of the Drmno opencast mine was slowed down and the new startup date was reported for 1982. Initial yearly capacity was planned at 6 million tons with the possibility for expansion to 9 million tons at a later date. Both mines (Ćirkovac and Drmno) were planned to deliver lignite to two power-generating plants. At yearend, one plant, a 210-megawatt facility, was near completion; and the second plant, a 600-megawatt facility, was planned.

New reserves, about 4.5 million tons of brown coal, were discovered at the Bogovina mine near Zaječar. This new reserve brought the total proven reserves at Bogovina to 7 million tons, which at the 1976 rate of production will be adequate for 20 years.

In the general area of Štavalj, near Sjenica, Sandžak Province, Serbia, discovery of about 200 million tons of brown coal was announced, but there were no immediate plans for development.

Coke.—Construction of a coking plant at Bakar continued according to plans. An underwater tunnel, 400 meters long, was completed during 1976. Equipped with a conveyor belt, the tunnel was planned to transport coal to the plant from a bulk ore port at Bakar, Croatia, which is situated on the other side of the Bakar inlet. When completed in 1977, the Bakar plant should produce 850,000 tons of coke per year. Plans exist for doubling capacity in the future.

Imports of coke started to decline reflecting 1 full year of operation of new coking facilities at Lukavac, in Bosnia. A downtrend in coke imports is expected to con-

Table 4.—Yugoslavia: Supply and apparent consumption of energy-producing materials for 1974 and 1975

(Million tons of standard coal equivalent [1])

	Total energy	Coal all kinds and coke trade	Petroleum and trade in refinery	Natural gas	Fuelwood	Hydroelectric power
1974:						
Production	27.3	17.1	5.1	2.0	0.5	2.6
Imports	18.6	2.5	16.1	(2)	(2)	(2)
Exports	.8	.4	.4	(2)	(2)	(2)
Apparent consumption	45.1	19.2	20.8	2.0	.5	2.6
1975:						
Production	30.0	18.8	5.7	2.3	.6	2.6
Imports	15.1	2.8	12.3	(3)	(3)	(3)
Exports	.4	.1	.3	(3)	(3)	(3)
Apparent consumption	44.7	21.5	17.7	2.3	.6	2.6

[1] 1 ton of standard coal equivalent (SCE) = 7,000,000 kilocalories.
[2] Insignificant.
[3] Less than 0.01 million tons of SCE.

tinue and imports of coke are scheduled to end in 1978 when the new coking plant near Bakar will be operational.

Natural Gas.—The high cost of imported liquid hydrocarbons made domestic natural gas more attractive. Construction of a large gas pipeline system continued during 1976 in Serbia and remained the major activity in the natural gas sector of the industry. When the 1,260-kilometer trunk pipeline with a capacity of 2.5 to 4.5 billion cubic meters per year is completed, it will connect the gasfield in Vojvodina with consumers in Serbia and Bosnia. Construction of the whole system was delayed and a new completion date was reported for the latter part of 1979. At yearend, 90 kilometers of the system were completed and the cement plant at Beočin will become a user of natural gas in 1977. In Croatia, construction of an 800 million-cubic-meter-per-year natural gas processing plant continued near Ivanić Kloštar. Ethane is to be piped by INA-Naftaplin to Zagreb for production of ethylene. INA-Naftaplin will operate the facilities. In Slovenia, a credit of $60 million was arranged for financing a pipeline system for transportation of gas from Austria to consumers in Slovenia. Details on the capacity and length of the system were not made public at yearend.

During 1976, domestic output of natural gas was adequate. However, in the future imports of gas from Hungary and the U.S.S.R. will be necessary to meet the demand that is being created by gasification of cities. Naftagas was the major producer of natural gas in the country and accounted for about 51% of the total output. INA's largest gasfield was Bokšić Lug in Slavonia. Two natural gas processing plants, Ivanic Klostar and Mramor Brdo, produced about 90,000 tons of butane and propane. In addition, Naftagas operated its largest gasfield near Kikinda, Vojvodina, and gas processing plants in Elemir and Mokrin with an aggregate output of about 20,000 tons of products.

Petroleum.—In 1976 domestic production of crude oil reached an all-time high of 3.8 million tons (about 75,000 barrels per day). However, about 70% of 1976 refinery throughput was imported. Iran, Iraq, and the U.S.S.R. were the principal suppliers of crude oil. INA, and Naftagas, headquartered in Novi Sad, Serbia, remained the only producers and most important refiners of crude oil in Yugoslavia. INA was by far the largest, accounting for about 70% of the country's total crude oil output. Six refineries, three operated by INA (Rijeka, Sisak, and Lendava), two by Naftagas (Novi Sad and Pancevo), and one by Energoinvest (Bosanki Brod) had an installed annual capacity of 13.2 million tons.

Exploration, Development, and Production.—During 1976 the Pannonian sedimentary basin in north Yugoslavia remained the principal area for active petroleum and natural gas exploration and development. Exploration offshore in the Yugoslav part of the Adriatic was limited to assessment of results obtained during recent drillings and preparation for further drilling. INA-Naftaplin in Croatia and Naftagas in Serbia carried out exploratory and development drilling in the Pannonian Basin. Approximately 175,000 meters were drilled by Naftaplin and about 101,000 meters by Naftagas during 1976, and new discoveries were made at Slavonija and Banat. However, further drilling will be required to assess the economic importance of the new discoveries. The stepout well in the Kikinda Field in Banat and Benicanci Field in Slavonija showed possibilities for significant extensions.

In the Adriatic, INA was preparing locations for an offshore drilling rig, the first owned and operated by Yugoslav enterprises, expected to start drilling during 1977. In the south, Yugopetrol-Adriatica (a joint venture between Buttes Gas & Oil Co., Challenger Oil & Gas Co., and Yugopetrol-Kotor) completed the first well, Juzni-Jadran 1. Casing was set at 3,300 meters and reportedly high-pressure gas zones were encountered. At yearend 1976, a decision was made to drill a second well in the area.

All of the crude oil production in Yugoslavia came from approximately 32 fields situated in the Pannonian Basin. Beničanci, Slavonija Province, Croatia, operated by INA-Naftaplin, was the largest oil producing field in the country.

One field, Palić, located near the city of Subotica, north Yugoslavia, started production in the fall of 1976. The field, operated by Naftagas, was scheduled for production of 70,000 tons of crude oil per year in 1977.

In addition, Yugoslavia carried out drilling and exploration abroad. INA was active in Syria, Burma, and Bangladesh; Naftagas in Africa, mainly Guinea.

Refineries.—Six State-owned refineries processed a total of 11.8 million tons of crude and operated at 89% of its installed capacity. Imported crude oil, mostly from Iran, Iraq, and the U.S.S.R., accounted for about 70% of the total refinery throughput. Although domestic output was far below demand, and high prices of imported crude oil burdened the economy, expansion of petroleum refining capacities remained one of the major targets for the industry.

Two new refineries, one in Koper, Slovenia, and another in Skopje, Macedonia, were scheduled for construction. However, both projects were in early stages of planning and no firm data on capacity, financing, and marketing of products were available at yearend 1976. In addition, plans were made for expansion of refineries at Rijeka (to 8 million tons annually), Sisak (to 6.7 million tons), Bosanski Brod (to 3 million tons), and Novi Sad (to 2.5 million tons). During 1976, a new lube plant and asphalt plant went onstream at the Novi Sad petroleum refinery operated by Naftagas. Capacity of the lube plant was not made public, but the asphalt plant is to produce 80,000 tons of bitumen per year.

On March 27, 1976, representatives of Dow and INA concluded an agreement for investment of about $700 million in a petrochemical complex on the island of Krk in the northern Adriatic.

The Krk joint venture is to be financed according to a new Yugoslav law regulating investments of foreign capital. INA will provide 51% of the total investment and retain controlling interest. Dow will supply the rest. In addition, Dow will introduce the latest U.S. technology for the new installations. Imported raw material will be used as feedstock, but its origin was not determined at yearend.

The new enterprise is to operate under the name DINA. DINA will be part of INA and operate under Yugoslav law. Construction started in 1976, and completion is scheduled for 1982. Final capacity of the complex will be 1.8 million tons per year of various petrochemical products.

Transportation.—Construction continued on the 1,200-kilometer crude oil trunk pipeline from Omisalj on the island of Krk, where a tanker port with storage facilities for crude oil and pumps for moving oil over the Dinaric Alps were situated, to inland refineries in Yugoslavia, Hungary, and Czechoslovakia. The pipeline will have an annual capacity of 34 million tons, when completed in 1978 or 1979.

The Mineral Industry of Zaire

By Miller W. Ellis [1]

Zaire's mineral industry was adversely affected by transport difficulties and the resulting lack of fuels and export facilities in 1976. Despite lower production of most mineral commodities, Zaire continued to lead the world in production of cobalt, germanium, and industrial diamond, and ranked sixth in copper output. The Benguela Railway remained closed throughout the year, and traffic to and from the mineral-rich Shaba Region was diverted to longer and more costly routes. Exports of Shaba's mineral products by way of the internal rail-barge-rail route to the river-seaport of Matadi were reportedly below the 1975 tonnages.

The country's monetary unit, the zaire, was worth US$2.00 until March 12, 1976, when it was equated with one Special Drawing Right (SDR) of the International Monetary Fund (IMF), then worth approximately $1.15. Zaire's inability to service its external borrowings resulted in discussions with creditor nations and arrangements for refinancing to insure continuity of projects vital for the expansion of the mineral industry.

Lack of sufficient electrical power contributed to diminished utilization of copper refining capacity at Kolwezi. The high-voltage, direct-current transmission line from Inga, on the lower Zaire River, to the Shaba copperbelt was still incomplete at yearend. A British firm was negotiating for construction of a rail link between Ilebo, on the Kasai River, and a railhead at Kinshasa to obviate river barge transport. Studies were completed for a road and railway bridge from Matadi to the north bank of the Zaire River, a railway to the Atlantic port of Banana, and larger deepwater docks at Banana for more efficient handling of large freighters and tankers.

The Zairian firm La Générale des Carrières et des Mines du Zaire (Gécamines) acounted for the country's production of cadmium, cobalt, germanium, zinc, and most of the copper and silver. Shortages of fuel oil resulted in intermittent operation of heavy mining equipment, and production of refined metal and wirebar casting was restricted by a lack of coke. Gécamines' staff was increasingly involved in negotiating and implementing arrangements for alternative export routes. Because Gécamines' products earned most of Zaire's foreign exchange, the company was allowed direct access to 45% of its foreign exchange credits, and had to assume additional responsibility for acting as purchasing and export agent on behalf of other Zairian companies. Société de Développement Industriel et Minièr du Zaire (Sodimiza), 80% owned by a Japanese consortium, operated at a loss owing to the increased cost of rail transport of its concentrate to a South African port en route to Japan.

PRODUCTION

Lack of transport and fuel caused a general decline in production of most Zairian mineral commodities in 1976. Mine production of copper was more than 10% below that of 1975, but it accounted for nearly 60% of the total value of Zaire's mineral products. Cobalt remained Zaire's second greatest foreign exchange earner

[1] Physical scientist, International Data and Analysis.

although production of metal was more than 20% lower than in 1975. Zaire's first-year offshore crude oil production of more than 9 million barrels placed this new commodity on its list of foreign exchange earners. The 1976 production of industrial diamond decreased 10%, zinc 11%, and tin 26%. Production of silver as a copper-zinc industry byproduct increased 8%. Details of mineral production are shown in table 1 and export data are listed in table 2.

Table 1.—Zaire: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Cadmium, smelter production	r 263	264	260
Cobalt:			
Mine output, metal content	r 17,632	r e 14,000	e 11,000
Refinery production	17,565	13,638	10,686
Columbium-tantalum concentrate	r 64	80	79
Copper:			
Mine output, metal content	499,428	496,331	444,610
Blister and leach cathodes	r 462,000	462,600	408,230
Refined	r 254,552	225,900	66,018
Germanium, content of concentrates—kilograms	61,653	11,865	NA
Gold [1]—troy ounces	r 130,603	103,217	102,882
Manganese ore and concentrate, gross weight	308,775	308,525	156,612
Rare-earth metal, monazite concentrate, gross weight	220	298	240
Silver—thousand troy ounces	1,694	2,291	2,472
Tin:			
Mine output, metal content	r 4,675	4,562	3,776
Smelter, primary	571	647	478
Tungsten, mine output, metal content	196	248	e 240
Zinc:			
Mine output, metal content	84,464	79,300	70,300
Metal, primary, electrolytic	66,182	65,588	61,677
NONMETALS			
Cement, hydraulic—thousand tons	r 621	628	e 630
Diamond:			
Gem—thousand carats	620	395	591
Industrial—do	12,991	12,415	11,230
Total—do	13,611	12,810	11,821
Lime e	150,000	150,000	150,000
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous—thousand tons	95	89	100
Petroleum:			
Crude—thousand 42-gallon barrels	--	25	9,075
Refinery products:			
Gasoline—do	1,034	1,056	579
Kerosine and jet fuel—do	566	644	318
Distillate fuel oil—do	1,278	1,191	698
Residual fuel oil—do	1,953	1,352	878
Liquefied petroleum gas—do	20	21	12
Refinery fuel and losses—do	278	232	245
Total—do	5,129	4,496	2,730

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Excludes gold recovered from blister copper.

TRADE

Early in 1976, the State-owned agency Société Zairoise de Commercialisation des Minerais (Sozacom) experienced difficulty in marketing copper products, and its functions were returned to the Belgian firm Société Générale des Minerais S.A. (SGM). Arrangements were made for SGM to hold 45% of sales revenue in a hard currency account in Europe, and to use these funds directly for purchases and payments authorized by Gécamines. This procedure eased Gécamines' cash flow problems and expedited delivery of equipment and supplies in Zaire. By November, proposals were made for a new agency, owned 50% by SGM and 25% each by Gécamines and Sozacom, to be responsible for marketing, purchasing, and recruitment in Europe by November 1978.

The port of Matadi handled about 237,000 tons of mineral exports during 1976, some 12% less than in 1975. The East African Railways Corporation reportedly handled 70,000 tons of copper and 25,000 tons of zinc shipped from Shaba by way of Lake Tanganyika to Dar es Salaam, Tanzania. Except for some 6,500 tons of tin and various mineral concentrates from the eastern Shaba and Kivu Regions, the remainder of Shaba's mineral exports were shipped through Zambia, Southern Rhodesia, and Botswana to a South African port.

During the early part of the year, Zairian exports through Zambia transited Southern Rhodesia en route to Mozambique ports. After Mozambique closed its Southern Rhodesian border, such exports were diverted from Bulawayo through Botswana to South African ports. The extra transport costs diminished Gécamines' income on copper metal exports and resulted in a loss for Sodimiza because of the lower unit value of concentrate (34% to 36% copper) shipped to Japan for smelting. The returning railcars were loaded with bulky imports, chiefly coke, coal, maize, and other foodstuffs needed to maintain production in the Zairian copperbelt.

The relegation by the Zairian National Railways of Sodimiza's exports to the southern route was largely dictated by Zaire's need for maximum import capacity on the return trip. The relative difficulty of transshipping concentrate to Tazara's railcars in Zambia, the incompatibility of braking systems on Zairian and Tazaran railcars, and a restriction on the number of Zambia's dual-system cars allowed to enter Zaire further mitigated against Sodimiza being allocated any of Tazara's limited capacity in excess of Zambia's high-priority requirements.

In early August, Zairian Railways announced an increase of approximately 75% in freight rates within Zaire. Both Gécamines and Sodimiza protested against the increase and negotiations were in progress at yearend. Gécamines' commodities from its industrial centers at Lubumbashi, Likasi, and Kolwezi travelled 230, 360, and 520 kilometers, respectively, over Zairian lines to the Zambian port of entry at Sakania, or more than 1,000 kilometers to river barge transport at Ilebo or to the lake steamer at Kalemie. Sodimiza's concentrate was produced at Musoshi near the railroad and the Zambian frontier, but had to travel 150 kilometers eastward over Zairian lines to the Sakania border post en route to East London, Republic of South Africa.

The most recent official information available on imports was that for 1970 which appeared in the Zaire chapter of the 1972 Minerals Yearbook.

Table 2.—Zaire: Apparent exports of selected mineral commodities
(Metric tons unless otherwise specified)

Commodity		1974	1975
Abrasives, natural	value, thousands	NA	$5,437
Copper:			
Ore and concentrate		93,528	92,088
Metal including alloys, all forms		445,662	389,599
Diamond	value, thousands	$1,105	$2,789
Iron and steel, scrap		--	2,210
Manganese ore and concentrate		165,445	150,877
Tin:			
Ore and concentrate		5,631	5,901
Metal, unwrought		523	951
Tungsten ore and concentrate		408	349
Uranium and thorium ores and concentrates		NA	87
Zinc:			
Ore and concentrate		4,393	--
Metal, unwrought		32,741	15,651
Other:			
Ores and concentrates	value, thousands	NA	$537
Base metals including alloys, all forms		NA	[1] 2,215

NA Not available.
[1] Excludes quantity valued at $1,733,000.

Source: Statistical Office of the United Nations. World Trade Annual, Walker and Co., New York. Vs. 1, 2, and 3, 1974, and vs. 1, 2, and 3, 1975.

COMMODITY REVIEW

METALS

Aluminum.—Exploitation of bauxite deposits near Sumbi, 150 kilometers northeast of Banana, was further discussed as a joint project of the Zairian Government (55%) with Alusuisse. Power from the Inga project would be used for an aluminum refinery as part of an industrial complex near projected deepwater port facilities at Banana. Zairian authorities were also reportedly negotiating with Reynolds Metals Co. of the United States for construction of a second aluminum plant in this vicinity.

Copper, Cobalt, Zinc, Associated Metals (Shaba Region).—The 1976 slump in production from the mineral-rich Shaba Region was caused by the disruption of transport facilities following closure of the Benguela Railway outlet through Angola to the Atlantic port of Lobito in August 1975. Longer and more expensive alternative routes caused shortages of diesel fuel, coke, and other commodities required for mining and metallurgical operations, and resulted in an inadvertent compliance with production limitations proposed by the Conseil Intergouvernemental des Pays Producteurs et Exporteurs du Cuivre (CIPEC) at its Lima, Peru, meeting in November 1975. The CIPEC limitations were not extended beyond their expiration date of June 30, 1976.

Transport difficulties, which were also responsible for increased costs of production and sales, coupled with depressed copper prices on the world market, drastically reduced the profitability of Shaba's mineral industry on which some 75% of Zaire's foreign exchange and about half of Government revenue depended. Gécamines, the Government-owned successor to Union Minière du Haut Katanga (UMHK) and other companies previously responsible for recovery and refining of cobalt, zinc, germanium, cadmium, silver, gold, and other byproducts, continued to dominate the industry. Shortages of diesel fuel interrupted operations at most of Gécamines' pits including those at Dikuluwe and Mashamba near Kolwezi. Late delivery of equipment contributed to delays in construction of nearby concentrating, smelting, and refining facilities as part of Gécamines' second 5-year expansion plan. Work toward completion of the high-voltage, direct-current transmission line from Inga on the lower Zaire River, vital to the expansion plan, continued during 1976.

Gécamines produced about 408,000 tons of copper, 92% of Zaire's mine output in 1976, and accounted for all of Zaire's output of cobalt, zinc, germanium, and cad-

mium, most of its silver, and part of its gold.

Zaire continued to hold a 20% interest in the Sodimiza operations near the Zambian border at the eastern end of the Zairian copperbelt. The remaining 80% was held by a consortium including Nippon Mining Co., Ltd., Sumitomo Metal Mining Co., Ltd., Mitsui Mining & Smelting Co., Ltd., Nissho-Iwai Co., Ltd., Furukawa Mining Co., Ltd., Toho Zinc Co., Ltd., Mitsubishi Metal Corporation, and The Dowa Mining Co., Ltd. Of the more than 3,600 employees, only about 150 were Japanese cadre, most of whom were Nippon employees. Sodimiza's output of copper sulfide concentrate was intended for shipment to Japan as raw material for smelting, refining, and fabrication by the Japanese industry.

Sodimiza accounted for 8% of Zaire's copper production from its Musoshi mine and 140,000-ton-per-month concentrator. Development of its Kinsenda mine continued and monthly delivery of 14,000 tons of Kinsenda ore to the Musoshi concentrator was scheduled to start in October 1977. The 1976 Musoshi concentrator output was reportedly 102,000 tons of copper sulfide concentrate containing 35.5% copper, equivalent to 36,210 tons of copper metal. These figures represent increases of 8% and 12%, respectively, over Sodimiza's 1975 production. The amount of cobalt and other byproducts in the Musoshi concentrate was not available. Sodimiza's concentrate was initially shipped to Japan through Angola to the Atlantic port of Lobito, and the returning railcars carried a substantial amount of imports to the Shaba Region. When this route was closed in August 1975, concentrate shipments were diverted through Zambia and Southern Rhodesia to the Indian Ocean port of Beira, and the returning cars brought coke, grain, and other imports to Shaba. In March 1976, the Mozambique-Southern Rhodesian border was closed and Sodimiza's concentrate was rerouted from Bulawayo in Southern Rhodesia through Botswana to the South African port of East London. Returning railcars continued to carry fuel and food vital for Shaba's industries. In respect to equivalent copper metal tonnages exported, Sodimiza required about three times the number of railcars needed by Gécamines.

Société Minière de Tenke-Fungurume (SMTF) suspended construction of its copper-cobalt mining and metallurgical complex east of Kolwezi in January 1976 because of financial difficulties following delays in receipt of fuel and equipment. The project was placed on a care-and-maintenance basis with some 850 Zairian and 30 expatriate employees at a monthly cost of about $400,000. By yearend, a reevaluation of the situation indicated that a reduction of production targets from 130,000 tons to 95,000 tons of copper cathodes per year and from 6,000 tons to 4,500 tons of cobalt per year might be envisaged at a capital cost of about $650 million in addition to the $275 million already expended.

Columbium-Tantalum, Gold, Tin, Tungsten.—Soc. Zairetain's operation near Manono in the east-central part of Shaba Region was shut down by a strike on July 19 because workers demanded a wage increase similar to one granted Gécamines earlier in the month. The Government ordered a lockout, and within a few days a broken sluice gate emptied the reservoir of water impounded to wash out the cassiterite ore during the dry season. Production could not be resumed until November after the onset of the rains had replenished the reservoir. Two of Zairetain's mines were then reopened and 1,500 of the original 2,800 workers were able to return to work, but production of tin metal and tantaliferous slag was only about 65% of that attained in 1975.

In the Kivu Region, Compagnie Belge d'Entreprises Minières (Cobelmine), a 1975 amalgamation of previously independent mining companies, and Syndicat Minière de l'Etain (Symetain) were finally consolidated into a single company, Société Minière de Kivu (Sominki). A Presidential ordinance signed March 31, 1975, officially established 20% Zairian ownership of the new company with headquarters at Bukavu and an administrative office at Kinshasa. Sominki had about 18,500 employees, 105 of which were expatriates, and was responsible for more than $20 million worth of export credits for gold, cassiterite (tin ore), columbite-tantalite, wolframite, and monazite. Some $230,000 was expended on metallurgical research and exploration for new ore.

Iron and Steel.—The Zairian Government operated a small steel plant, the Sidurna Works, at Makulu on the Zaire River near Kinshasa, which produced some 3,000 tons of steel sheet, rod, and shapes from scrap in 1974 and 1975. In early 1976, iron deposits at Banalia and Libundu were appraised, and plans were announced for their joint exploitation by German companies and the Zairian Government. The project was to operate within the International Association for the Industrialization of Northeastern Zaire. The deposits were previously reported by the French Bureau de Recherches Géologiques et Minières (BRGM), which was continuing its authorized inventory of Zaire's mineral resources outside the area allocated to Gécamines and other major mining companies.

Manganese.—Mining operations continued at a diminished rate at the Kisenge deposits near the Benguela Railway, approximately 100 kilometers east of the Angolan frontier in the southwestern Shaba Region. Société Minière de Kisenge (SMK) was Zairian owned and managed, with some 700 employees including a few expatriates. The low-unit-value ore had been exported profitably by way of the Benguela Railway, but after the closure of this export route in August 1975, all production was stockpiled. The 1976 output was about 156,600 tons, and some 550,000 tons of ore was reportedly in the stockpile at yearend. In August and September 1976, representatives of Mitsubishi of Japan were exploring possibilities for upgrading SMK's output at the mines. Later in the year SMK reportedly contracted to export 100,000 tons of ore over the southern route as soon as railcars became available.

NONMETALS

Cement.—Most of Zaire's cement was produced and consumed in the Shaba Region. Cimenteries du Shaba (Cimshaba) operated three rotary kilns at Lubumbashi and sold nearly 70% of its output to Gécamines. Other customers included Sodimiza and Constructeurs Inga-Shaba (CIS), the U.S. company partly responsible for building the electrical transmission line. Cimshaba's production was below 1975 output because of shortages of firebrick and containers. Lack of foreign exchange was partly alleviated by a $600,000 credit line with three Belgian banks, and should be obviated by Gécamines' purchase of 40% of Cimshaba's stock in December 1976. Clinker produced by Cimshaba was sold to Ciments Metallurgiques de Likasi (CML), a subsidiary of Gécamines. CML's lime and cement production was all consumed by the parent company.

The Ciments-Laçs operation at Kabimba, near Kalemie on Lake Tanganyika, was halted in October 1975 because the nearby Makala coal mine was shut down for lack of spare parts and diesel fuel. During 1976, Ciments-Laçs produced only 40,000 tons of cement but officials were optimistic that full-scale operations would resume early in 1977.

Cement plants were also reportedly planned or operating at Kinshasa and Kisangani. A new marble quarry was started near Kimpese in lower Zaire by Itenco-Marbreza Co. Some of the output was to be used by Chinese workmen in the construction of the Kinshasa "Palace of the People." Contracts for the sale of marble to neighboring countries were being sought.

Diamond (Kasai Region).—Intermittent shortages of diesel fuel caused temporary shutdowns of heavy equipment at open pit mines operated by Société Minière de Bakwanga (MIBA) in the Mbuji-Mayi area, and resulted in the lowest industrial diamond production for some 25 years. A small part of the production came from small-scale private operations, especially in the old Tshikapa fields near the Angolan frontier. Such production was sold to local buying agents. Zaire's annual industrial diamond production quota of 13.5 million carats was set by Zaire-British Diamond Distributors, Ltd. (Britmond), an affiliate of the Central Selling Organization, which has started training Zairians to sort and grade the local production in Kinshasa.

Stone.—*Ornamental.*—Malachite, the green carbonate of copper, has been used as an ornamental stone, for carvings, and for gems for many centuries. The export of malachite from "Cazembe's country" (formerly Katanga, now Shaba) was noted in 1799 and recorded in "Lacerdas Journal." Both Burton and Livingstone reported it as a trade commodity in the late 1850's, along with copper metal readily smelted from it by aboriginal metallurgists. Until 1960, malachite was the most im-

portant copper mineral in all of UMHK's mines except Kipushi, and a large quantity of malachite was profitably exported annually under strict control. During the 1960–67 post-independence disturbances, illicit export of malachite commenced on a large scale and sale of the mineral was prohibited within the country. In 1976, new regulations provided for Gécamines to transport raw malachite to three agencies in Kolwezi, Likasi, and Lubumbashi, where it was sold to approved craftsmen working in cooperatives or prepared for export. During 1976, Zairian malachite could be purchased in the United States at prices ranging from $10 to $30 per pound depending on quality and size.

MINERAL FUELS

Coal.—Although no production figures were available from La Société des Charbonnages de la Luena, 250 kilometers north of Kolwezi, it seemed probable that some coal was mined for the production of copper and cement. A new coal gasification plant was included as part of Gécamines' expansion plan. Coal from the Makala Field near Kalemie on Lake Tanganyika was reportedly used in the nearby cement plant. Coal and coke were imported from Zambia, Southern Rhodesia, and the Republic of South Africa. At yearend, negotiations were reported for the import of 200,000 tons of West German coal by way of Dar es Salaam.

Petroleum.—Crude oil production from Zaire's offshore fields commenced at yearend 1975, and more than 9 million barrels was reported for 1976, making oil Zaire's third most valuable mineral product. Three firms participated in offshore oil production: Zaire Gulf Oil Co., Japan Petroleum Zaire, and Muanda Oil Co., a subsidiary of the Belgian firm Cometra Oil. The Zairian Government retained a 15% interest in each of the concessionary firms. It was reported that some of the crude oil was shipped to the Moanda refinery near Banana, but the high pour point, paraffin, and saltwater content made it unsuitable for the local refinery. Plans to double capacity of the refinery were reported to include modifications for handling the local crude. Refinery production of about 2.5 million barrels of liquid fuels was far below local consumption, which was expected to increase as transport facilities improve and Shaba's mining industry expands. Construction of a small-diameter pipeline to carry diesel fuel from Zambia's Ndola refinery to Shaba's copperbelt was postponed for lack of financing.

Onshore oil exploration had involved an aeromagnetic survey in late 1973 by the U.S. firm L.K.B. Resources Inc., a fluvial-seismic survey by the British firm Seismograph Service Ltd., and a territorial seismic survey by a subsidiary of the French Compagnie Générale de Geophysique in 1974 and 1975, on behalf of the concessionaires Shell Centrex and Texaco Inc. Shell Centrex subsequently engaged Seismograph Service to provide a unit in Kinshasa to process and interpret the seismic data. By yearend 1974, approximately $5 million had been expended and field exploration was halted while interpretation of results continued. In mid-1976, Shell Centrex withdrew from the project for budgetary reasons and Texaco was negotiating a new agreement with the Zairian Government. Correlation of geophysical results with Earth Resources Technological Satellite (ERTS) photography indicated the possibility of potential oil deposits near Akula, near the equator some 700 kilometers northeast of Kinshasa, where field assessment was started in 1976.

The Mineral Industry of Zambia

By Miller W. Ellis [1]

Zambia continued to rank as the world's fifth largest producer of copper in 1976, and Zambia's mineral exports continued to provide more than 90% of its foreign exchange. With the gradual improvement in the international copper price, both of its major copper-producing companies, Nchanga Consolidated Copper Mines Ltd. (NCCM) and Roan Consolidated Mines Ltd. (RCM), were operating at a profit by mid-1976.

In January 1976, full emergency and austerity measures were announced because of the continued low price of copper and the transport difficulties aggravated by the closure of the Benguela Railway through Angola in August 1975. Import permits were restricted to the most essential items, and applications for the externalization of funds were approved only when foreign exchange credits became available. Only essential categories of expatriate staff could be retained or recruited. The mineral industry was given a high priority for exchange control needed to maintain production levels and to complete projects for the expansion of metal production. Imports of food and nonessential consumer goods were restricted, and domestic production of such commodities was encouraged.

On July 8, 1976, the Zambian currency (kwacha) was devaluated and was fixed in terms of Special Drawing Rights (SDR) of the International Monetary Fund (IMF) instead of the U.S. dollar.[2] This resulted in an increase in the domestic kwacha value of both exported and imported commodities. The direct effect on the mineral industry was negligible, but the local cost of imported consumer goods increased about 25%.

The Tanzania-Zambia Railway (Tazara) carried increasing amounts of Zambian exports and imports, and by July 14, when the line was officially opened, virtually all of Zambia's transport problems had been resolved.

In real terms, the gross domestic product (GDP) increased 2.4% in 1976, following a 3% decline in 1975. In terms of local currency, the increase was nearly 15%. The increase was owing to greater production by the mineral and agricultural industries.

PRODUCTION

Zambia's blister copper production increased 7% from 659,000 tons in 1975 to 706,000 tons in 1976, but production of zinc declined 21%, lead 29%, and cobalt 7%. Details of mineral production are shown in table 1.

[1] Physical scientist, International Data and Analysis.

[2] Where necessary, values have been converted from Zambian kwacha (K) to U.S. dollars at the rate of K1=US$1.4019 for 1976 and K1=US$1.5541 for 1975 as shown in International Financial Statistics. V. 30, No. 12, December 1977, p. 392.

Table 1.—Zambia: Production of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976 p
METALS			
Cadmium metal	13	6	5
Cobalt:			
Mine output, metal content of concentrate	2,846	3,164	e 3,300
Metal	r 1,962	1,843	1,720
Copper:			
Mine output:			
Total content of ore	883,804	806,273	849,642
Recoverable content of concentrate	697,956	676,921	708,867
Blister and anodes, copper content [1]	r 709,500	659,028	705,906
Refined	676,854	629,150	694,943
Gold [2] ---troy ounces	e 8,500	e 8,500	10,955
Iron ore, magnetite	420	223	e 100
Lead:			
Mine output:			
Total content of ore	r 35,776	26,082	15,549
Recoverable content of ore	24,600	19,400	14,800
Smelter (refined)	r 24,596	19,100	13,610
Silver [3] ---thousand troy ounces	e 1,100	e 1,000	1,065
Tin concentrate, gross weight	11	e 10	([4])
Zinc:			
Mine output:			
Total content of ore	r 80,704	67,298	48,777
Recoverable content of ore	58,300	46,900	37,900
Smelter plus electrolytic	r 58,300	46,800	37,100
NONMETALS			
Cement, hydraulic ---thousand tons	444	366	e 385
Feldspar	1,777	1,174	517
Fluorspar	460	e 500	3
Gem stones:			
Amethyst ---kilograms	37,425	32,000	25,878
Beryl ---do	11	NA	--
Emerald ---do	NA	NA	18
Gypsum	3,771	7,536	3,597
Lime, hydraulic, and quicklime ---thousand tons	e 110	e 110	144
Pyrites, gross weight	71,094	19,046	e 22,240
Stone:			
Limestone ---thousand tons	840	755	565
Phyllite ---do	NA	22	6
Sulfur, elemental basis (produced as sulfuric acid):			
From pyrite	29,220	7,295	e 9,100
From copper ore	49,312	81,057	e 89,800
From lead-zinc ores	4,848	4,183	e 3,300
Total	r 83,380	92,535	e 102,200
Talc	138	164	106
MINERAL FUELS AND RELATED MATERIALS			
Coal, bituminous ---thousand tons	r 809	898	753

e Estimate. p Preliminary. r Revised. NA Not available.

[1] Includes leach cathodes.

[2] Chiefly contained in blister copper and refinery muds; estimated level of output for all producers; previously reported figures at a lower level did not include total national output.

[3] Refined silver and silver contained in blister copper and refinery muds.

[4] Less than ½ unit.

TRADE

The closure of the Benguela Railway because of civil unrest in Angola was followed by acceleration of work on the Tazara line. Freight- and passenger-handling facilities were completed throughout the system. Port facilities at Dar es Salaam were improved and enlarged to handle additional cargo while the Tazara roadbed stabilized to carry heavier loads and additional traffic. Zambian rolling stock was fitted with a second braking system so that it would be compatible with new rolling stock provided by the People's Republic of China.

All copper stocks within Zambia had been shipped and the backlog of imports had been cleared from Dar es Salaam before the July 14 ceremony when the Chinese Deputy Prime Minister officially handed over the Railway operation to the Presidents of Zambia and Tanzania at the Zambian junction town of Kapiri Mposhi, 160 kilometers south of the Copperbelt.

Truck routes to connect with railheads in Malawi and Mozambique were opened but were little used because of deteriorating roads and conditions for handling cargo at the Mozambique ports of Nacala and Beira.

An untarred truck route was completed from Francistown in Botswana to the Zambezi River at Kazungula, 80 kilometers upstream from Victoria Falls. Traffic was limited by the capacity of the ferry installation at Kazungula. A study of routes, rolling stock, loading, handling, and transfer capacities, and costs in respect to export and import requirements was assessed by officials of Zambian, Tanzanian, and Zairian Government agencies and mining and railroad companies. The Zambian requirements were allocated first priority for use of the Tazara route to Dar es Salaam, but RCM was also allocated low tonnages for road transport to Moatize and rail transport to the Beira harbor in Mozambique. NCCM also was to utilize a similar route through Malawi to the port at Nacala in Mozambique.

Zambia has been a net exporter of electricity since the first Kafue Gorge hydroelectric units were commissioned in 1972. With the startup of the Kariba North Bank hydroelectric station in May 1976, Zambia has been able to supply increasing industrial and export demands. Thermal power stations at most industrial centers were maintained for emergency standby capacity.

During the 5-year period 1970–74, Zambia's imports from the United States had an average annual value of about $60 million, while exports averaged less than $5.5 million. In 1975, the value of imports more than doubled, but export sales dropped to less than $250,000. This situation was dramatically reversed in 1976 when the value of imports from the United States decreased to about $60 million, and exports soared to nearly $150 million. Except for a general decline in imports during 1976, the trend of Zambia's trade relationships with other major trading partners has been relatively stable since 1970.

The value of Zambia's 1972–76 trade, in million dollars, is shown in the following tabulation:

	1972	1973	1974 r	1975	1976 e
Copper exports	814	1,092	1,303	735	965
Total exports	845	1,160	1,407	810	1,054
Total imports	628	544	787	929	657
Balance of trade (exports minus imports)	+217	+616	+620	−119	+397

e Estimate. r Revised.

The positive balances, however, do not indicate an accumulation of foreign exchange credits because of expenditures on loan repayments and overseas dividends and other disbursements. The 1975 current account deficit of more than $600 million was reduced to about $144 million in 1976.

Table 2 shows the amounts and destinations of mineral exports, and table 3 lists the amounts and sources of mineral imports.

Table 2.—Zambia: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	68	40	All to United Kingdom.
Cobalt metal, unwrought	1,894	1,344	Mainly to United Kingdom.
Copper:			
Copper-bearing residues	1,428	1,761	Sweden 664; Belgium-Luxembourg 455; Japan 389.
Metal:			
Scrap	--	24	All to United Kingdom.
Unwrought:			
Unrefined blister	35,570	18,087	United Kingdom 11,652; Yugoslavia 1,656.
Refined:			
Wire bar	520,095	456,110	United Kingdom 82,253; Italy 74,889; Japan 74,221.
Cathode	116,304	165,563	United Kingdom 53,171; Japan 47,880; West Germany 28,649.
Total	636,399	621,673	
Semimanufactures	(1)	--	
Iron and steel metal:			
Scrap	10	--	
Semimanufactures, including ferroalloys	432	920	Mainly to Zaire.
Lead:			
Oxide	82	119	Zaire 50; Malawi 36.
Scrap	872	489	Italy 213; Mozambique 122.
Unwrought and semimanufactures	18,776	19,376	Italy 8,700; Yugoslavia 5,101; Republic of South Africa 3,619.
Platinum-group and silver metals including alloys ---troy ounces	996	360	All to United Kingdom.
Tin ore and concentrate	20	--	
Zinc metal:			
Scrap	49	--	
Unwrought	50,227	41,264	Italy 12,705; Yugoslavia 12,108; Netherlands 6,891.
NONMETALS			
Abrasives: Pumice, emery, natural corundum, etc	(1)	--	
Cement	5,218	2,058	All to Zaire.
Chalk	(1)	(1)	NA.
Fertilizer materials:			
Manufactured, nitrogenous	687	580	Mainly to Zaire.
Ammonia	--	1,200	All to Zaire.
Lime	36	--	
Mica, all forms ---kilograms	104	33	All to United Kingdom.
Precious and semiprecious stones, except diamond ---value, thousands	$580	$1,197	NA.
Stone, crushed and broken	13,744	17,075	All to Zaire.
Sulfuric acid, oleum	15,756	14,060	Mainly to Zaire.
Talc	345	--	
MINERAL FUELS AND RELATED MATERIALS			
Carbon black and gas carbon	2	--	
Coal, all grades, including briquets	23,020	--	
Petroleum:			
Partly refined ---42-gallon barrels	--	37	All to Zaire.
Refinery products:			
Gasoline ---do	11	2,436	Do.
Kerosine ---do	24	2	Do.
Distillate fuel oil ---do	--	201	Do.
Lubricants ---do	204	453	Do.
Bituminous mixtures ---do	315	11	All to Malawi.
Other ---do	--	787	All to Zaire.
Total ---do	554	3,890	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	--	(1)	NA.

NA Not available.
1 Less than ½ unit.

Table 3.—Zambia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum metal:			
Scrap	2	--	
Unwrought and semimanufactures	703	1,225	United Kingdom 504; Israel 153; Tanzania 147.
Antimony:			
Ore and concentrate	17	13	All from Belgium-Luxembourg.
Powder	30	20	All from People's Republic of China.
Arsenic trioxide, pentoxide, acids	17	15	West Germany 10; United Kingdom 5.
Chromium:			
Chromite	1	--	
Oxide and hydroxide	7	1	All from West Germany.
Metal including alloys, all forms	3	--	
Cobalt metal including alloys, all forms	(1)	51	Mainly from Zaire.
Copper:			
Copper sulfate	110	77	Mainly from United Kingdom.
Metal including alloys, all forms	426	551	United Kingdom 264; Italy 104; Zaire 66.
Iron and steel:			
Ore and concentrate, except roasted pyrite	40	2	All from United Kingdom.
Metal:			
Scrap	2,164	(1)	NA.
Pig iron, ferroalloys, similar materials	1,914	705	Norway 400; United Kingdom 142.
Steel, primary forms	527	1,218	Japan 751; United Kingdom 466.
Semimanufactures	169,075	128,623	Japan 64,816; United Kingdom 23,327; Republic of South Africa 15,794.
Lead:			
Oxides	1	(1)	NA.
Metal including alloys, all forms	33	25	United States 12; United Kingdom 11.
Manganese:			
Oxide	247	579	All from Republic of South Africa.
Ore and concentrate	--	3	All from United Kingdom.
Nickel metal including alloys, all forms	15	9	Mainly from United Kingdom.
Platinum-group metals including alloys, all forms ---troy ounces	2,715	708	All from United Kingdom.
Silver metal including alloys ---do	1,890	1,586	United Kingdom 655; West Germany 617.
Tin metal including alloys, all forms	37	65	Singapore 23; United Kingdom 23.
Titanium oxides and dioxides	139	1,089	West Germany 180; France 163.
Zinc:			
Oxide	254	171	United Kingdom 122; Australia 31.
Metal including alloys, all forms	7	2	Mainly from West Germany.
Other:			
Ores and concentrates	(1)	1	Mainly from United States.
Metals including alloys, all forms, n.e.s	77	134	Do.
Oxides, hydroxides, peroxides of metals, n.e.s	(1)	92	Mainly from United Kingdom.
NONMETALS			
Abrasives:			
Pumice, emery, natural corundum, etc	23	(1)	NA.
Grinding and polishing wheels and stones	156	149	United Kingdom 97; West Germany 27.
Asbestos	3,017	2,765	Swaziland 1,861; Republic of South Africa 904.
Barite	83	30	Kenya 25; West Germany 4.
Boron oxides and acid	(1)	3	All from United Kingdom.
Bromine	61	38	Mainly from Israel.
Cement	1,316	2,159	United Kingdom 1,325; People's Republic of China 440.
Chalk	204	363	United Kingdom 299; Kenya 61.
Clays and clay products (including all refractory brick):			
Crude:			
Fire clay	--	1	All from United States.
Fuller's earth	108	8	All from Republic of South Africa.

See footnotes at end of table.

Table 3.—Zambia: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Clays and clay products (including all refractory brick)—Continued			
Crude—Continued			
Kaolin	195	376	Mainly from West Germany.
Other	2,480	1,043	Republic of South Africa 724; United States 185.
Products, refractory (including nonclay bricks)	315	160	United Kingdom 68; United States 35.
Diamond, industrial ——thousand carats	57,010	53,870	Mainly from United Kingdom.
Diatomite and other infusorial earth	419	280	United States 113; France 80.
Feldspar and fluorspar	253	1	Mainly from United States.
Fertilizer materials:			
Crude, phosphatic	1,720	57	United Kingdom 35; People's Republic of China 20.
Manufactured:			
Nitrogenous	80,426	134,625	Republic of South Africa 71,324; Italy 31,684.
Phosphatic	9,490	14,623	Republic of South Africa 10,773.
Potassic	1,420	230	Mainly from Republic of South Africa.
Other, including mixed	1	(1)	NA.
Ammonia	34	12	West Germany 7; United Kingdom 5.
Graphite, natural	2	2	Mainly from Republic of South Africa.
Gypsum and plasters	208	177	West Germany 121; United Kingdom 54.
Magnesite	2	10	All from West Germany.
Mica, all forms	1	1	Mainly from United Kingdom.
Pigments, mineral, including processed iron oxides	287	218	United Kingdom 190; West Germany 23.
Precious and semiprecious stones, including diamond ——value, thousands	$14	$24	Mainly from United Kingdom.
Salt	12,124	20,687	United Kingdom 7,562; Mozambique 6,543; Angola 4,763.
Sodium and potassium compounds:			
Caustic soda	2,835	2,270	Italy 644; Japan 411; United States 396.
Caustic potash and sodic and potassic peroxides	r 61	76	West Germany 61; United Kingdom 15.
Soda ash	2,588	3,603	Kenya 2,731; Japan 800.
Stone, sand and gravel:			
Stone:			
Dimension stone	28	3	All from Pakistan.
Dolomite	1	--	
Gravel and crushed rock	96	14	Mainly from People's Republic of China.
Quartz and quartzite	6	14	Do.
Sand, excluding metal bearing	9	57	United Kingdom 37; Australia 20.
Sulfur:			
Elemental, all forms	3,154	18,114	Iraq 12,943; Iran 5,086.
Sulfuric acid	285	38	United Kingdom 23; Kenya 15.
Talc and steatite	22	58	India 44; United Kingdom 7; Italy 5; United States 2.
Other:			
Crude	(1)	6	Mainly from United Kingdom.
Slag, dross, and similar waste, not metal bearing	15	79	All from United States.
Oxides and hydroxides of magnesium, strontium, barium	1	1	Mainly from United Kingdom.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals	257	155	Austria 41; Sweden 40; People's Republic of China 28.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,130	290	Jamaica 188; United Kingdom 100.
Carbon black	1,183	1,683	United States 903; Republic of South Africa 548.
Coal and coke, including briquets	93,936	16,240	Mainly from West Germany.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	6,183	8,858	All from Saudi Arabia.

See footnotes at end of table.

Table 3.—Zambia: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum—Continued			
Refinery products:			
Gasoline-thousand 42-gallon barrels	25	37	Mainly from Iran.
Kerosine ---do---	16	6	All from United Kingdom.
Distillate fuel oil ---do---	2	--	
Lubricants ---do---	308	185	Mainly from United Kingdom.
Other:			
Mineral jelly and wax ---do---	29	26	People's Republic of China 10; Indonesia 7; United States 6.
Unspecified ---do---	8	4	Mainly from People's Republic of China and United Kingdom.
Total ---do---	388	258	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r 1	(1)	NA.

r Revised. NA Not available.
1 Less than ½ unit.

COMMODITY REVIEW

METALS

Copper and Byproduct Cobalt.—Zambia's two major copper companies mined and treated nearly 33.7 million tons of ore with a total copper content of nearly 825,000 tons during fiscal 1976. NCCM produced approximately 17.9 million tons of ore containing nearly 500,000 tons of copper, and RCM divisions accounted for about 15.8 million tons of ore containing more than 325,000 tons of copper.

The following tabulation shows ore mined and treated and ore reserves at the various mines operated by RCM for its fiscal year ending June 30, 1976:

Mine	Ore mined and treated			Ore reserves	
	Gross weight (thousand metric tons)	Percent copper	Copper content (metric tons)	Gross weight (thousand metric tons)	Percent copper
Mufulira [1]	6,700	2.15	144,050	144,634	3.08
Luanshya [1]	4,920	1.19	58,736	69,023	2.46
Baluba [1]	1,280	2.58	33,024	64,342	2.58
Chambishi [2]	1,450	2.28	33,060	41,542	2.89
Chambishi [1]	635	2.45	15,558		
Chibuluma [1]	610	3.70	22,577	8,212	4.67
Kalengwa [2]	209	8.72	18,248	918	6.92
Kalulushi East [1]	--	--	--	5,900	4.09
Total	15,804	2.06	325,253	334,571	2.90

1 Underground.
2 Open pit.

RCM reported its fiscal 1976 production at 280,994 tons of finished copper and sales at 271,431 tons, down 3% and 6%, respectively, from the 1975 figures. The average sales price declined 12% to $1,254 per ton for fiscal 1976, but both production rate and copper prices improved during the last half of 1976. The Mufulira underground mine acounted for 45% of RCM's production. Trackless mining methods facilitated ore extraction in the western "flat-dip" area, but most of Mufulira's ore came from the eastern part of the mine where rehabilitation of workings affected by the 1970 "mud-rush" was nearly completed. A subvertical shaft system was started to extract ore below the 580-meter level in the eastern part of the mine. The total cost was estimated at about $62 million, and final commissioning was planned for about 1984. Nearly $20 million was proposed for improvements of materials-handling facilities

in the smelter complex, scheduled to be completed by early 1979.

RCM's Luanshya operation was adversely affected by poor ground conditions, resulting in dilution of ore from the Roan Antelope mine. Shortages of equipment and spare parts and a lack of skilled, experienced staff contributed to decreased output and higher production costs. An upcast ventilation shaft was completed at the western part of the mine (the Muliashi section), and surface fans were installed. The No. 5 ventilation shaft at Baluba was started, and the No. 2 shaft was deepened below the 370-meter level. Four compressors worth more than $5 million were ordered. A new rotary dryer was installed, and the converter and anode aisles were extended at the Luanshya smelter. The $7.5 million coal preparation plant was commissioned to deliver 540 tons of pulverized fuel per day.

Installation of the headframe and equipping of the 1,000-meter main hoisting shaft (No. 3) at RCM's Chambishi open pit was nearly completed, but 635,000 tons of ore was produced through continued use of trackless methods for underground mining down dip from the pit. The open pit produced 1.45 million tons of ore, and 7.22 million tons of overburden was stripped. Oxidized ore was treated in the vat leaching plant, and more than 65,000 tons of concentrates, including cobaltiferous concentrate from Chibuluma and Baluba, was treated in the roast-leach plant. Cobalt hydroxide containing 640 tons of cobalt was recovered from the leach solutions and sent to Nkana for further treatment. The electrowinning plant produced about 16,000 tons of leach copper cathodes. Sulfide concentrate was shipped to the Mufulira smelter. Interesting copper mineralization was intersected at depths of 700 to 800 meters in several drillholes located about 10 kilometers southeast of the Chambishi mine.

At Chibuluma, the No. 3 shaft was deepened, and the new No. 7 shaft at the Chibuluma West ore body was more than 600 meters deep. Shaft sinking and construction of a surface plant was resumed at the Kalulushi East ore body, 10 kilometers south of Chibuluma. More than 2.5 million tons of overburden was removed at the Kalengwa mine, and less than one-tenth of that amount of ore was recovered. The Kalengwa concentrator treated about 100,000 tons of ore, and a similar amount of high-grade ore was trucked to the Copperbelt. Low-grade ore and concentrator tailings were stockpiled for future treatment. Open pit extraction of the Kalengwa ore body should be completed in about 2 years, but there was sufficient ore stockpiled for the concentrator to operate for at least 5 years. Methods for recovering additional copper from Kalengwa tailings were being tested.

Anodes from Luanshya continued to provide most of the feed for RCM's Ndola Copper Refinery. Construction of a plant for treatment of anode slimes was completed, and operations were started by yearend. The figures for gold, silver, copper, and selenium recovery reported for 1976 probably included amounts of these metals contained in untreated stocks of tankhouse sludge.

Some 2,960 tons of cobalt was contained in the 2 million tons of ore treated at Chibuluma and Baluba, but only 640 tons was recovered as hydroxide at the Chambishi roast-leach plant. The intimate chemical and physical mixture of cobalt with copper and iron sulfides prevented recovery of more than about 30% of cobalt in the cobalt concentrate, from which both copper and cobalt were recoverable by the roast-leach process. Most of the cobalt remained in the copper sulfide concentrate and, like the iron, was incorporated in the smelter slag.

The fiscal year for NCCM, that ending March 31, 1976, was a period of depressed copper prices and increased transport difficulties. Copper production was reported at 385,414 tons and sales at 386,201 tons, down nearly 6% and 3%, respectively, from the figures reported for 1975. The average sales price received was $1,197 per ton of copper, 29% lower than the 1975 average. Ore mined and treated and ore reserves of NCCM in fiscal 1976 are shown in the following tabulation:

Mine	Ore mined and treated			Ore reserves	
	Gross weight (thousand metric tons)	Percent copper	Copper content (metric tons)	Gross weight (thousand metric tons)	Percent copper
Nkana [1]	5,047	1.59	80,247	117,354	2.40
Mindola [2]	895	2.85	25,490		
Bwana Mkubwa [2]	1,147	2.76	31,657	4,025	3.51
Nchanga [1]	2,877	3.70	106,318		
Nchanga [2]	4,759	3.33	158,475		
Chingola [1]	500	3.19	15,966	285,242	3.29
Chingola [2]					
Mimbula [2]	330	2.39	7,887		
Fitula [2]	556	3.71	20,628		
Konkola [1]	1,675	3.11	52,109	122,982	3.53
Nampundwi [1]	90	1.00	899	23,083	.77
Total	17,876	2.80	499,676	552,686	3.05

[1] Underground.
[2] Open pit.

The two underground and four open pit mines of NCCM's Chingola Division produced about 9 million tons of ore. More than 22 million cubic meters of overburden was removed from the Nchanga open pit, nearly 2 million cubic meters from Chingola, and 3.6 million cubic meters from Mimbula and Fitula. The Chingola concentrator treated more than 8 million tons of the ore, and nearly 1 million tons was shipped to the Konkola concentrator. The recently commissioned tailings leach plant extracted 74,215 tons of copper from almost 7 million tons of Chingola tailings, a small amount of reclaimed oil tailings, and nearly 1.4 million tons of low-grade oxide concentrate, high-grade leach plant slimes, residues, and liquor. A second large-diameter drain was completed from the Nchanga open pit sump into the underground workings where a new $10.7 million underground pumping station was commissioned. The station replaced two older ones and was reported to have a safe capacity of nearly 120,000 cubic meters of water per day with about 40% additional emergency capacity. Subsidence and foundation movement owing to acid spillage interfered with production at the high-grade leach plant. A fifth thickener was added to the tailings leach plant at a cost of nearly $4 million.

More than one-half of the 5 million tons of sulfide ore treated at the Rokana Division concentrator came from the Mindola shaft near the northern part of the Nkana ore body. A new shaft to enhance production from this section was scheduled to commence operation in September 1977. A 250-ton-per-hour crusher and a 465-meter conveyer system were installed at Rokana's central shaft. Production from the Mindola open pit was halted at the end of January, but was resumed at a lower rate in June when copper prices improved. Waste heat boilers and gas collection systems were commissioned on the No.'s 4, 5, and 6 converters to complete installation of the $38 million sulfuric acid plant.

Development work expanded and production improved at NCCM's Konkola mine where water continued to be the major problem. The pumping rate increased to an average of nearly 375,000 cubic meters of water per day, equivalent to more than 80 tons of water per ton of ore hoisted. Treatment of Nchanga ore at the Konkola concentrator was discontinued early in 1976. Konkola's sulfide concentrate was sent to the Rokana smelter, and oxide concentrates were treated in leach plants at Nchanga.

The Nkana cobalt plant accounted for all of Zambia's production of cobalt. Nkana's 5 million tons of ore had a cobalt content of approximately 4,540 tons. Finished metal production was about 1,700 tons, including nearly 630 tons derived from cobalt hydroxide produced at Chambishi from RCM's Chibuluma and Baluba concentrates. Reopening of NCCM's Kansanshi mine, 160 kilometers west of the Copperbelt, was resumed at yearend.

The Mokambo copper mine, jointly owned by the Romanian company Geomin and the Zambian State organization Mindeco Limited, was put on a care-and-maintenance basis in July after severe flooding

delayed commencement of production in February.

Lead, Zinc, Byproduct Cadmium.—NCCM's Broken Hill Division produced and treated 360,000 tons of galena-sphalerite ore containing 7.0% lead and 18.3% zinc during its fiscal year. Finished output for that period included 21,274 tons of lead, 21,025 tons of high-purity zinc, 24,833 tons of over 98.5% zinc, 13,264 tons of sulfuric acid, and 12,900 kilograms of cadmium. No silver was produced by the Division during the fiscal year owing to plant rehabilitation and resiting of the silver cupellation furnace. During the last half of fiscal 1976, underground production of ore declined chiefly because of excavation of a subvertical shaft for extraction of ore below the 1,400-meter level. Surface plant rehabilitation included installation of a new zinc leaching process and construction of a fine coke plant to improve operating conditions and stabilize throughput of the three Waelz kilns.

Other.—Eluvial workings located 60 kilometers east of Choma and supervised by Mindeco Small Mines Ltd. produced 292 kilograms of the tin mineral cassiterite. Manganese deposits west of Mansa were investigated as a source of raw material for the manufacture of dry cell batteries. Proposals for exploitation of iron ore west of Solwezi and for operation of an oil-fired steelworks in that vicinity were being studied. The Zambian Government reportedly signed a contract for construction of a 250,000-ton-per-year sponge iron plant. The Geological Survey continued drilling to explore potential uranium ore near Siavonga on the northern shore of Lake Kariba.

NONMETALS

NCCM's Nampundwe "pyrite" mine west of Lusaka produced nearly 16,000 tons of cupriferous pyrite concentrate containing nearly 6,000 tons of sulfur and more than 700 tons of copper. The concentrate was shipped to Nkana and treated along with NCCM's sulfide copper concentrates at the Rokana smelter. Total fiscal year production of sulfuric acid by NCCM was about 288,000 tons, most of which was used in the leach treatment of Copperbelt ores. About 32,000 tons of gypsum, recovered from the Rokana cobalt plant liquor, was railed to Chilanga Cement Ltd. The Lochinvar mine and washing plant west of Monze produced 3,600 tons of gypsum. Chilanga Cement continued to supply most of the country's requirements for cement, but the amount it produced in 1976 was not reported. Quarries east of Ndola produced 565,000 tons of limestone for flux and aggregate and supplied 144,000 tons of lime to be used in metallurgical processes and building construction. A small mine near the Kariba Dam supplied more than 500 tons of feldspar and 3 tons of fluorite for glassmaking at Kapiri Mposhi. Production of amethyst declined from 32,000 kilograms in 1975 to less than 26,000 kilograms in 1976. Its sales value averaged about $28 per kilogram. Mindeco resumed emerald mining near Miku, south of Chibuluma, and recovered 17.6 kilograms of emeralds with a value of about $1,260 per kilogram.

MINERAL FUELS

Indeni Petroleum Refining Co., Ltd., imported 6,854,000 barrels of Saudi crude oil by way of pipeline from Dar es Salaam to the Ndola refinery. This supplied most of Zambia's requirements for gasoline, jet fuel, dieselene, and heavy fuel oil, but 2,840 barrels of aviation spirit for piston engine planes was imported from Iran, and nearly 15,000 barrels of lubricating oil came from various sources. Construction to double the capacity of the refinery was started, and plans for a small-diameter pipeline from Ndola to the Zairian copper belt were revived and again shelved for lack of financing. More than 750,000 tons of washed coal was produced at the Maamba colliery and transported to consumers along the railroad and to smelting centers at Broken Hill and in the Copperbelt.

The Mineral Industry of Other Areas of Africa

By Staff, International Data and Analysis

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THE TERRITORY OF AFARS AND ISSAS [1]

The Territory of Afars and Issas is to receive its independence from France on June 27, 1977. The Territory's economic income was based on entrepôt trade through the port of Djibouti and transshipment of goods on the Chemin de Fer Franco-Ethiopian (CFE) railroad. The Territorial budget was scheduled to increase from $32.6 million [2] in 1976 to $36 million in 1977, despite severe shortfalls in 1976 stemming from inflation and a persistent balance-of-trade deficit. Subsidies from France continued to sustain the economy, and the French pledged to provide approximately $140 million in aid annually after independence. In 1976, financial agreements were concluded with a number of Arab oil-producing countries, including Saudi Arabia which granted $10 million toward development projects. The new Republic of Djibouti is scheduled to become the 49th member State of the Organization of African Unity (OAU) and the 21st member of the Arab League, and to receive aid from their financial institutions.

The port of Djibouti and the CFE railroad constituted the Territory's main economic resources. Traffic at the port greatly

[1] Prepared by Candice Stevens, economist, International Data and Analysis.

[2] Where necessary, values have been converted from Djibouti francs (DF) to U.S. dollars at the rate of DF175=US$1.00.

increased in 1976 owing to limited access to the Eritrean ports of Massawa and Assab in Ethiopia. Approximately 2,000 ships called at the port during the year, carrying 480,000 tons of petroleum products and 380,000 tons of other freight. Nearly 75% of the trade consisted of Ethiopian imports and exports. Activity on the 780-kilometer CFE railroad, which linked Djibouti and Addis Ababa, similarly increased. A total of 200,000 tons of freight transited the railroad in 1976. Since 1959, the railroad has been jointly owned by France and Ethiopia, but negotiations were underway to transfer French interests to the Territory of Afars and Issas. Another major project, construction of a 247-kilometer highway linking Djibouti and Addis Ababa, was near completion at yearend.

Potential mineral projects in the Territory consisted of extraction of gypsum and salt from Lake Asal and construction of a cement plant at Mount Arrey near Ali Sabieh based on local limestone deposits. Legislation enacted in 1975 and 1976 was aimed at encouraging foreign investment in mineral and petroleum exploration and exploitation through providing various tax exemptions and economic incentives. Evaluation of geothermal resources in the area of Lake Asal continued in 1976 with technical and financial assistance from the Bureau de Recherches Géologiques et Minières (BRGM) (France).

Table 1.—Other Areas of Africa: Production of mineral commodities

Country,[1] commodity, and unit of measure	1974	1975	1976 p
BÉNIN [2]			
Salt, marine ---- metric tons	2,500	150	e 3,000
Stone, gravel ---- do	15,000	e 16,000	NA
BOTSWANA [2]			
Coal (not further described) ---- do	r 25,498	71,248	224,175
Cobalt:			
Mine output, metal content e ---- do	33	81	157
Metal ---- do	e 8	e 8	3 71
Copper, Cu content of copper-nickel matte ---- do	2,380	6,490	12,482
Diamond:			
Gem e ---- thousand carats	408	r 360	354
Industrial e ---- do	2,310	r 2,037	2,007
Total ---- do	2,718	2,397	2,361
Gem stones, semiprecious, rough (not further described) kilograms	36,500	65,000	41,000
Manganese ore and concentrate, gross weight ---- metric tons	8	--	--
Nickel, Ni content of copper-nickel matte ---- do	2,630	6,440	12,579
Sulfur, byproduct, metallurgy ---- do	6,440	--	--
Talc ---- do	--	225	144
BURUNDI [2 4]			
Clays, kaolin ---- do	--	--	2,362
Columbium-tantalum ore and concentrate ---- kilograms	--	--	4,000
Gold ---- troy ounces	360	368	426
Lime ---- metric tons	630	798	622
Rare-earth metals, bastnasite concentrate, gross weight ---- do	r 273	82	139
Tin ore and concentrate:			
Gross weight ---- do	113	80	50
Sn content ---- do	80	56	33
Tungsten (W content) ---- do	1	1	2
CAMEROON [2]			
Aluminum metal, primary ---- do	46,842	51,913	57,724
Cement, hydraulic ---- do	201,399	238,071	298,909
Gold, mine output, metal content ---- troy ounces	64	96	251
Pozzolana ---- metric tons	NA	NA	17,880
Stone:			
Limestone ---- do	49,193	46,951	60,463
Marble ---- do	1,096	1,047	638
Tin ore and concentrate:			
Gross weight ---- do	36	36	19
Sn content ---- do	r 19	19	10
CENTRAL AFRICAN EMPIRE [2]			
Diamond:			
Gem e ---- carats	r 204,594	202,602	171,604
Industrial e ---- do	r 136,396	135,069	114,403
Total ---- do	340,990	337,671	286,007
Gold e ---- troy ounces	64	529	400

See footnotes at end of table.

Table 1.—Other Areas of Africa: Production of mineral commodities—Continued

Country,[1] commodity, and unit of measure	1974	1975	1976 p
CHAD [2]			
Natron:			
Slab (plaques) ——metric tons	1,149	3,572	e 4,000
Broken ——do	1,149	3,572	e 4,000
CONGO [2]			
Cement ——do	50,000	45,000	e 50,000
Copper, mine output, metal content ——do	930	919	408
Fertilizer materials, potash, crude, K_2O equivalent ——do	r 288,224	280,106	256,521
Gas, natural:			
Gross e ——million cubic feet	23,000	14,000	13,000
Marketed ——do	r 665	591	539
Gold, mine output, metal content e ——troy ounces	r 7,009	r 5,281	5,000
Lead, mine output, metal content ——metric tons	r 1,650	1,997	2,544
Petroleum, crude ——thousand 42-gallon barrels	22,434	13,460	14,274
Zinc, mine output, metal content ——metric tons	r 3,342	4,475	5,301
ETHIOPIA [2 5]			
Cement, hydraulic ——do	208,246	145,000	148,500
Clay, kaolin ——do	r e 40,000	50,000	45,000
Coal, lignite ——do	308	240	e 200
Copper:			
Gross weight ——do	1,900	e 1,900	e 1,900
Metal content e ——do	r 400	r 400	400
Gold, mine output, metal content ——troy ounces	15,754	19,981	11,253
Gypsum and anhydrite, crude ——metric tons	1,666	--	--
Lime ——do	r 5,014	--	--
Petroleum refinery products:			
Gasoline ——thousand 42-gallon barrels	597	585	672
Jet fuel and kerosine ——do	210	174	198
Distillate fuel oil ——do	1,395	1,246	1,451
Residual fuel oil ——do	1,464	1,408	1,471
Other:			
Liquefied petroleum gas ——do	40	35	36
Asphalt ——do	90	62	55
Unspecified ——do	6	--	--
Refinery fuel and losses ——do	483	430	454
Total ——do	4,285	3,940	4,337
Platinum, mine output, metal content ——troy ounces	230	162	145
Salt:			
Rock e ——metric tons	r 10,000	r 10,000	10,000
Marine ——do	121,932	75,840	88,000
Stone, limestone ——do	16,198	7,315	8,500
Talc ——do	3	25	e 25
GUINEA [2]			
Aluminum:			
Bauxite, gross weight ——thousand metric tons	7,605	8,406	10,848
Alumina ——do	r 665	643	560
Diamond: e			
Gem ——thousand carats	25	25	25
Industrial ——do	55	55	55
Total ——do	80	80	80
IVORY COAST [2]			
Cement, hydraulic ——thousand metric tons	r 634	710	768
Diamond:			
Gem e ——thousand carats	112	92	22
Industrial e ——do	167	117	38
Total ——do	279	209	60
Fertilizer materials, manufactured, mixed ——metric tons	e 40,000	e 40,000	44,500
Petroleum refinery products:			
Gasoline ——thousand 42-gallon barrels	2,023	2,163	2,193
Jet fuel and kerosine ——do	1,023	1,108	1,101
Distillate fuel oil ——do	3,081	3,370	3,595
Residual fuel oil ——do	3,503	3,946	4,709
Liquefied petroleum gas ——do	93	110	110
Refinery fuel and losses ——do	421	369	490
Total ——do	10,144	11,066	12,198
LESOTHO [2]			
Diamond:			
Gem ——carats	1,767	444	891
Industrial ——do	9,540	2,068	4,125
Total ——do	11,307	2,512	5,016

See footnotes at end of table.

Table 1.—Other Areas of Africa: Production of mineral commodities—Continued

Country,[1] commodity, and unit of measure	1974	1975	1976 [p]
MALAWI [2]			
Cement, hydraulic ---thousand metric tons	81	102	85
Gem and ornamental stones, agate ---metric tons	22	4	[e] 4
Kyanite ---do	NA	NA	[e] 90
Lime [e] ---do	250	250	250
Stone, sand and gravel:			
Limestone ---do	[r] 123,418	143,639	149,254
Shale ---do	[e] 100,000	NA	NA
MALI [2]			
Cement ---do	42,000	49,000	[e] 40,000
Gold, mine output, metal content ---troy ounces	[r] 30	300	300
Salt [e] ---metric tons	3,000	3,000	3,000
MAURITANIA [2]			
Copper, mine output, metal content ---do	20,079	16,203	9,431
Gold ---troy ounces	[e] 52,000	[e] 42,000	22,120
Gypsum ---metric tons	8,312	12,669	11,195
Iron ore and concentrate, gross weight ---thousand metric tons	11,666	8,677	9,664
Rare-earth metals, monazite concentrate, gross weight [e] metric tons	100	100	100
Salt, marine [e] ---do	[r] 1,000	[r] 1,000	1,000
Silver ---troy ounces	[e] 31,000	[e] 26,000	31,572
MAURITIUS [2]			
Lime ---metric tons	4,000	7,300	7,300
Rock, basalt (not further described) ---do	NA	NA	400,000
Salt ---do	5,000	6,000	5,500
NIGER [2]			
Cement, hydraulic ---do	20,500	17,635	36,240
Gypsum ---do	2,200	1,017	2,588
Salt [e] ---do	2,000	[r] 1,000	1,000
Stone, sand and gravel:			
Limestone (not further described) ---do	40,000	35,584	56,456
Gravel ---do	[e] 100.000	[e] [5] 49,500	[5] 322,682
Sand ---do	[e] 100,000	[e] [5] 4,700	[5] 10,687
Tin, mine output, metal content ---do	[r] 79	98	91
Uranium concentrate, U_3O_8 content ---do	[r] 1,317	1,540	1,722
RWANDA [2]			
Beryllium, beryl concentrate, gross weight ---do	[r] 59	18	46
Columbium and tantalum ore and concentrate, columbite-tantalite, gross weight ---do	[r] 75	47	45
Gas, natural:			
Gross ---million cubic feet	35	--	6
Marketed ---do	35	--	6
Gold, mine output, metal content ---troy ounces	643	425	936
Lithium minerals, amblygonite [e] ---metric tons	30	30	30
Tin, mine output, metal content ---do	[r] 1,550	1,422	1,605
Tungsten, mine output, metal content ---do	283	345	432
SENEGAL [2]			
Cement, hydraulic ---thousand metric tons	332	359	386
Clays, fuller's earth (attapulgite) ---cubic meters	4,810	8,217	2,277
Fertilizer materials, phosphatic:			
Crude:			
Aluminum phosphate ---thousand metric tons	[r] 405	201	208
Calcium phosphate ---do	1,472	1,682	1,591
Manufactured:			
Aluminum phosphate, dehydrated ---do	[r] 98	86	68
Other [6] ---do	[r] 5	8	7
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	851	912	980
Jet fuel and kerosine ---do	872	897	932
Distillate fuel oil ---do	985	1,043	1,144
Residual fuel oil ---do	1,793	1,916	1,855
Other ---do	31	52	67
Refinery fuel and losses ---do	148	173	153
Total ---do	4,680	4,993	5,131
Salt ---metric tons	150,000	132,539	141,953
Stone:			
Basalt ---cubic meters	83,929	NA	168,500
Marble (cipolino) ---do	120	350	250
SEYCHELLES [2]			
Phosphate rock (including coral rock phosphate) ---metric tons	3,541	[e] 3,000	5,670

See footnotes at end of table.

Table 1.—Other Areas of Africa: Production of mineral commodities—Continued

Country,[1] commodity, and unit of measure	1974	1975	1976 [p]
SOMALIA [2]			
Salt, marine [e] ——metric tons	2,000	2,000	2,000
SPANISH SAHARA [2]			
Fertilizer materials, crude phosphate rock——thousand metric tons	2,300	2,760	173
SUDAN [2]			
Cement, hydraulic ——do	[r] 196	216	130
Chromium, chromite concentrate, gross weight ——metric tons	20,000	15,000	21,873
Gold, mine output, metal content ——troy ounces	309	[e] 300	[e] 300
Gypsum and anhydrite, crude [e] ——metric tons	30,000	15,000	18,000
Magnesite, crude [e] ——do	100	100	100
Manganese ore ——do	--	--	485
Mica, all grades ——do	250	[e] 250	550
Petroleum refinery products:			
Gasoline ——thousand 42-gallon barrels	964	971	1,022
Jet fuel ——do	344	368	390
Kerosine ——do	248	277	285
Distillate fuel oil ——do	2,641	3,232	2,348
Residual fuel oil ——do	1,439	2,538	3,174
Other ——do	2,197	{404	135
Refinery fuel and losses ——do		{531	640
Total ——do	7,833	8,321	7,994
Salt ——metric tons	50,000	66,000	70,000
SWAZILAND [2 7]			
Asbestos, chrysotile ——do	32,421	41,219	41,847
Barite ——do	296	94	369
Clay, kaolin ——do	2,236	2,642	989
Coal, bituminous ——do	116,481	117,206	154,525
Iron ore, direct-shipping, gross weight ——thousand metric tons	2,481	1,964	1,744
Stone, quarry products ——cubic meters	41,043	37,966	50,618
Talc (pyrophyllite) ——metric tons	36	--	--
Tin, mine output, metal content ——do	[r] 1	1	2
TOGO [2]			
Cement, hydraulic (ground from imported clinker) ——do	127,819	150,000	166,737
Clays for brick production ——do	6,247	NA	NA
Fertilizer materials, phosphate rock, beneficiated product ——thousand metric tons	[r] 2,553	[r] 1,161	2,009
Salt ——metric tons	120	3,000	[e] 200
Stone, sand and gravel:			
Marble:			
Dimension ——do	2,233	12,896	NA
Broken ——do	2,360	NA	NA
Granite ——do	797	NA	NA
Sand and gravel ——cubic meters	144,514	NA	NA
UGANDA			
Beryllium, beryl concentrate, gross weight [e] ——metric tons	55	55	50
Bismuth, mine output, metal content [e] ——kilograms	4,000	4,000	4,500
Cement, hydraulic ——metric tons	[r] 150,007	98,400	87,600
Columbium and tantalum ore and concentrate, gross weight [e] ——kilograms	3,500	2,100	2,100
Copper:			
Mine output, metal content ——metric tons	12,243	8,500	7,000
Blister, primary ——do	8,915	8,300	7,000
Fertilizer materials, phosphatic:			
Crude, apatite ——do	11,000	10,000	5,000
Superphosphate ——do	[e] 24,000	NA	NA
Iron and steel, ingots ——do	[r] 12,000	15,000	[e] 12,000
Lime, hydrated, and quicklime [e] ——do	30,000	30,000	20,000
Salt, evaporated [e] ——do	3,000	[r] 1,000	500
Tin, mine output, metal content ——do	[r] 182	[e] 117	[e] 120
Tungsten, mine output, metal content ——do	97	58	[e] 58

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the countries listed individually in this table, Equatorial Guinea, the Territory of Afars and Issas, the Gambia, and Upper Volta, all covered textually in this chapter, presumably produce modest quantities of crude construction materials such as clays, stone, and sand and gravel, and may produce minor amounts of other mineral commodities (most notably gypsum, lime, and salt), but output is not reported quantitatively and available information is inadequate to permit formulation of reliable estimates of output levels.

[2] In addition to the commodities listed, modest quantities of unlisted varieties of crude construction materials (including clays, stone, and sand and gravel) presumably were produced, but output is not reported quantitatively and available information is inadequate to permit formulation of reliable estimates of output levels.

[3] Sales.

[4] Limited quantities of other pegmatite minerals may also be produced, but output is not recorded.

[5] Converted from reported figures in cubic meters using a factor of 1.8 metric tons per cubic meter.

[6] Products marketed under the trade names "baylifos" and "phospal."

[7] All figures reported are sales; actual production is not reported.

BENIN (formerly Dahomey) [3]

Activity in the mining sector of Bénin in 1976 was limited to exploration and feasibility studies. The small quantities of cement and salt produced during the year made a negligible contribution to the estimated 1976 gross domestic product (GDP) of $440 million.[4] The economy continued to suffer from severe inflation, and the balance-of-trade deficit was $67.3 million. In 1976, a planning commission was established to draw up the country's first 3-year plan (1977–79), which was to include a new investment code to attract foreign capital.

Foreign aid continued to support the development of Bénin's infrastructure, the deficiencies of which constituted an impediment to the country's mineral development. The U.S. Agency for International Development (AID) provided a $12 million loan for construction of a bridge-dam complex near the port of Cotonou. In addition, a $41 million port expansion program was under consideration by a consortium of international donors headed by the International Bank for Reconstruction and Development (IBRD). Société Béninо-Nigériene de Transports Routiers was created in 1976 as Nigeria pledged to finance a more direct coastal route linking Cotonou and Lagos. The African Development Bank (ADB) made a $2 million loan to Société Nationale d'Electricité et d'Eau (SNEE) for the expansion of electrical facilities. An agreement was signed with Togo for development of the Mono River Valley and construction of a dam at Mangbeto to supply 400 million kilowatt-hours of power per year.

In November, the Comité de Recherches Géologiques et Minières convened in Cotonou to unite the activities of the members of the Entente States Council in geological and mining research. The United Nations Development Program (UNDP), which operated a mineral exploration program in Bénin for 5 years, conducted followup work on previous findings of gold, copper, iron, chrome, and nickel mineralization. The Bénin Government initiated a feasibility study of phosphate deposits that extended 20 kilometers on a north-south axis near Kandi. Another interesting deposit discovered earlier in the UNDP program was the oolitic iron ore at Loumbou Loumbou. The area was estimated to contain 250 million tons of hematite ore averaging 50% iron, and the nearby Madékali deposit was estimated to contain 40 million tons of ore averaging 58% iron. Also in 1976, Bénin and Romania signed an accord for economic and technical cooperation, particularly in the areas of mineral exploration and petroleum exploration, development, and refining.

The only oil-prospecting activity in 1976 comprised seismic surveys by the Government in a concession area previously held by Union Oil Co., whose rights were terminated along with those of five other companies in 1974. Indemnification agreements were reached with the Royal Dutch/Shell Group in 1975 and Mobil Oil Corp. in 1976, and negotiations continued with Texaco Inc., Total Petroleum Ltd., British Petroleum Co. Ltd. (BP), and Agip S.p.A. Royal Dutch/Shell remained the only foreign company operating in Bénin but relinquished part of its 1,900-square-kilometer concession area in 1976. Bénin imported approximately 2 million barrels of petroleum products per year from Algeria, Niger, Venezuela, and the Ivory Coast; distribution was by the State agency Société Nationale de Comercialisation des Produits Pétroliers (SONACOP).

The cement factory at Cotonou, operated by Société Nationale des Ciments (SONACI), registered diminishing production in 1976 owing to maintenance problems. Work started in November 1976 on expansion of the plant from a capacity of 200,000 tons to 400,000 tons per year through the addition of a new clinker-grinding unit. The $10 million cost was to be financed by the Arab Bank for Economic Development in Africa and the Bénin Government. Output was to be sold domestically and exported to Nigeria and Niger.

Société des Ciments d'Onigbolo, a joint venture of Bénin (55%), Niger (40%), and a third technical partner, was to construct a 500,000-ton-per-year cement factory in Bénin. The plant was to be located near the limestone deposits in Onigbolo and Massé in the southeastern Pobé area, where reserves were estimated at 36 million tons. Other potential limestone deposits along the Nigerian border and in Zou

[3] Prepared by Candice Stevens.

[4] Where necessary, values have been converted from Communauté Financière Africaine francs (CFAF) to U.S. dollars at the rate of CFAF242 = US$1.00.

Province were under examination. F. L. Smidth & Co. A/S of Denmark was contracted to do feasibility studies for the $50 million plant.

BOTSWANA [5]

The mineral industry of Botswana contributed approximately $100.2 million to the nation's 1976 GDP of $173 million [6] in current prices, compared with $72 million in 1975. Mining made up 58% of the GDP, agriculture 32%, and construction 10%. Mine production included copper-nickel matte, valued at $59.3 million; diamond, $38.9 million; semiprecious stones, $16,000; talc, $21,850; and coal, $2 million. In 1976, Botswana's trade deficit was at a record low, and mineral production showed a significant improvement. Coal production more than tripled, and diamond production decreased slightly. Minerals made up almost 70% of total exports and 19% of total imports in 1976. Mineral imports were mainly fuels, valued at $22 million.[7]

The creation of an independent currency, the pula, in August 1976 and the withdrawal from the rand monetary area was a move toward monetary independence. The pula was pegged to the U.S. dollar. This was followed by a 5% up-valuation of the pula in early 1977. The value of imports was approximately two-thirds of the nation's GDP, and almost all foreign purchases came from the Republic of South Africa, so the revaluation helped Botswana to avoid the worst of its neighbor's inflation. Inflation has been at the rate of 12% to 14% each year since 1974 in Botswana. As a member of the South African Customs Union, Botswana usually benefits from a generous revenue-sharing formula. In the 1975–76 fiscal year, however, revenue from this source fell 19%, but the drop was more than offset by the increase in diamond revenues as a result of renegotiation of the company's financial structure in 1975.

Development expenditure has been consistently increased each year and was being directed toward infrastructure improvement. Botswana received $33.7 million from the European Development Fund (EDF), $20.2 million from the United Kingdom, and $6.9 million from Norway to build roads and other development projects.[8] The official opening of the Francistown-to-Nata road was to take place in 1977. This road forms part of the all-weather Botswana-Zambia (BOTZAM) highway system, which will stretch from Lobatse in southern Botswana to Kazungula on the Zambian border.

Botswana's policy on foreign investment is flexible; agreements are negotiated on all projects and are usually worked out so that the company can get a target return. If the project does better than anticipated, the company is granted a share of the "economic rent." There is no direct policy on Government participation, but in practice the Government likes to participate on an equal basis. Foreign companies are also permitted to operate external accounts. The Bank of Botswana reported that nearly $7 million more was externalized in the form of dividends than was gained by the Government in the forms of taxes and royalties in 1976.[9]

On the eastern flank of the country, mining companies were actively evaluating coal, uranium, and gold deposits. Two consortia were looking for oil and gas in central Botswana, and Shell Oil Co. and BP were carrying out a detailed evaluation of low-grade opencast coal deposits along the eastern north-south axis. By the end of 1977, the results of an aerial magnetic survey covering all of Botswana should be known. Copper was being sought in the Kalahari Desert, where it was suspected that deposits of the Zambian stratiform type were to be found.

A West German hydrogeologist began working in May 1976 with the Geological Survey of Botswana on preparing hydrogeological maps and training local personnel. An important assignment was the estimation of groundwater reserves and the amount of groundwater recharge. Priority projects were the water supply for a cattle slaughterhouse and for a soda factory in the city of Dukwe.[10]

[5] Prepared by Janice L. W. Jolly, physical scientist, International Data and Analysis.

[6] Where necessary, values have been converted from Botswana pula (P) to U.S. dollars at the rate of P1=US$1.15.

[7] Standard Chartered Review (London). Botswana. November 1977, p. 39.

[8] Africa Report (New York). Loans, Grants and Credits. November-December 1976, p. 36.

[9] Metal Bulletin Monthly (London). Botswana–Economic and Mineral Development. No. 79, July 1977, p. 32.

[10] Bundesanstalt für Gewissenschaften und Rohstoffe. 1975–76 Activity Report (Hannover). April 1977, p. 95.

Mining by De Beers Botswana Mining Co. (Pty.) Ltd. (Debswana) at Orapa was being expanded from an annual capacity of 2.35 million carats to 4.5 million carats, to be completed by the end of 1978. The expansion would bring the mine's total capital cost to about $57.5 million. The output was mainly industrial stone, about 15% gem quality. At the Letlhakane property, stage 1 of the development started in November 1976 at a production rate of about 70% of the target production of 320,000 carats per year. Stage 1 was scheduled to last for about 3 years. Stage 2 would involve mining the pipes themselves, which should yield about 396,000 carats per year for an additional 13 years, the life of the current lease. The diamond material was under strict security for final treatment at the highly sophisticated extraction plant at Orapa, where X-ray sorting machines give a virtual 100% diamond recovery. There is also a final handpicking of the waste gravels at this plant. Letlhakane's capital cost will total about $25.3 million. De Beers Consolidated Mines Ltd., the parent company, experienced record profits in 1976 to which Debswana contributed $38.9 million for 2,360,945 carats produced.

De Beers Consolidated was carrying out a large-diameter drilling program on the new diamond pipe discovery at Jwaneng in southern Botswana. To provide an accurate assessment of the deposit's potential, a detailed sampling program was planned, expected to last 4 years. In the meantime, De Beers Consolidated had initiated discussions with the Botswana Government for development and mining operations. The deposit is overlain by 50 meters of sand and calcrete but was considered to have economic potential.

Botswana RST Ltd., whose Selebi-Pikwe project operated by its subsidiary Bamangwato Concessions Ltd. (BCL) has been plagued by technical and financial problems since production started in late 1973, announced results for 1976 that suggested the mine was nearly breaking even. The company announced[11] an operating profit of $372,600, compared with a loss of $1.7 million in 1975. However, after deducting interest payments the net loss for the year was $29.6 million. In view of the high capital outlay expected, the company was restructuring financial arrangements, involving, among other things, a revision of the royalty paid to the Government and changes in the sale arrangements. Under the old agreement, Botswana was receiving a fixed annual royalty of $860,000, plus 7.5% of the profits, which have not materialized. Production at the mine was 32,506 tons of copper-nickel matte. Metals returned by the refinery at Port Nickel, Louisana, in 1976 were copper, 11,927 tons; nickel, 11,878 tons; and cobalt, 132 tons. Metal sales for the year amounted to $73,647,000. The company's cash requirements were provided by loans from Anglo American Corp. of South Africa Ltd., Charter Consolidated Ltd. Group, and American Metal Climax Inc. (Amax), the principal shareholders. The total indebtedness, including accrued interest, at fiscal yearend June 30, 1977, was $301.3 million. Although all technical problems that had delayed production for Botswana RST have been identified and corrected, serious difficulties still remained as the result of depressed world markets for copper and nickel.

The Selebi-Pikwe copper-nickel deposits of eastern Botswana comprise two stratabound sulfide bodies located 9 miles apart. The dominant sulfide is pyrrhotite which occurs with chalcopyrite and pentlandite. The Pikwe ore body was being mined by both underground and open pit methods. An underground mine at Selebi was to come into production in about 3 years. The Pikwe deposit comprised three zones: A southern massive 70% sulfide zone with grades up to 2.5% nickel and 1.5% copper, enclosed in gray gneisses; a central semimassive 40% to 70% sulfide zone, associated with amphibolite; and a northern low-grade, 0.8% nickel, 0.8% copper zone of disseminated ore. Production capacity was expected to be about 180,000 tons per month, with 110,000 tons of ore from underground operations and 70,000 tons from the open pit. In the steeper northern zone at Pikwe, mining was being done by the cut-and-fill method along 80-meter-long stopes supported by pillars at 20-meter intervals. In the more flatly dipping ore zones, the ore was extracted using open stopes with post sandfill.[12] The open pit was situated in the thick northern zone of the ore body.

[11] Botswana RST Ltd., company report for 6 months ended June 30, 1977.

[12] Vallentine, R. J. Selebi-Pikwe Copper-Nickel Project at Production Capacity. Skillings' Min. Rev., v. 66, No. 27, July 2, 1977, pp. 10–15.

The concentrator was operating at a milling rate of 6,000 tons per day. The smelter, designed to produce 3,500 tons per month of matte containing 1,275 tons of nickel and 1,452 tons of copper, was commissioned in late 1973 but did not achieve design production until August 1976. The drying plant, described as the largest operating mineral concentrate spray dryer in the world, was designed to produce 69.5 tons of concentrate per hour that is simultaneously mixed with silica flux for an output of 90 tons per hour of flash furnace feed. Until May 1975, the drying plant performance was poor because of inadequate slurry storage capacity, concentrate explosions in the storage silos, and the normal difficulties associated with startup. The problem of furnace feed control remained the most serious production restriction. In 1976, there were 378 expatriate and 1,139 local mine, smelter, and administrative employees. The size of the work force was attributed. especially in the underground operations, to labor-intensive mining methods and limited worker skills, requiring a man for each activity. A training program was resulting in marked improvement, from 1.9 tons to 2.8 tons per man-shift by mid-1976. New infrastructure associated with the mine includes a new town of 20,000 people, development of coal and water resources, and the addition of railroad lines, enhancing economic welfare in not only the eastern region but the entire country.

The Morupule colliery produced 224,175 tons of coal in 1976, valued at $1.98 million, enough to meet all of Botswana's present needs. Plans for underground expansion from 25,000 tons to 40,000 tons per month were being studied. Almost all coal was sold to Botswana Power Corp. (BPC) (20,000 tons per month) and BCL (5,000 tons per month). BPC was planning to expand the Gaborone power station with a $1.15 million investment. Bagged coal was also sold for local use, which never exceeds 325 tons per month even in peak winter months.

Reserves at Sua Pan (Makgadikgadi) were estimated as follows: 28 billion tons of soda ash (Na_2CO_3), 130 billion tons of salt (NaCl), 13 billion tons of sodium sulfate (Na_2SO_4), and 4 billion tons of potassium chloride (KCl). Gulf Resources and Chemical Corp. pulled out of the project for development of these deposits, which was estimated to require an investment of nearly $175 million, excluding much of the associated infrastructure. It was said to be almost impossible to evaluate the deposit because of the vagaries of salt concentration and associated minerals, but it was thought to be commercial.

BURUNDI [13]

The mineral industry of the Republic of Burundi showed its lowest recorded annual level of activity, owing primarily to changes in the Government and the large trade deficit resulting from increased oil prices.

In 1976, mineral production consisted of 139 tons of bastnäsite, 426 troy ounces of gold, 50 tons of cassiterite concentrate, 3 tons of tungsten ore, 622 tons of lime, 2,362 tons of kaolin, and 4 tons of columbium-tantalum ore. The lime output, reported for the first time, was consumed domestically in the construction industry.

Iran remained the country's main source of petroleum products in 1976. Burundi imported about 10,800 tons of gasoline, 1,600 tons of jet fuel and kerosine, 7,000 tons of distillate fuel oil, and 1,800 tons of residual fuel oil.

The investment code of Burundi remained quite liberal and ascribed special tax and tariff benefits to foreigners who wished to participate in the economic development of the nation. Labor costs were low, and in joint venture arrangements the Government expected to provide input such as land and utilities. The Overseas Private Investment Corp's. (OPIC) political risk insurance was available for direct investment and engineering projects. A United States-Burundi agreement on investment guarantees has been in effect since 1969. The Ministry of Planning was the principal Government agency handling new investments; however, following initial contacts, most of the substantive discussions were held on an interministerial basis with the pertinent operating ministries.

In the first 5 months of 1976, a mining and petroleum industry code was estab-

[13] Prepared by E. Shekarchi, supervisory physical scientist, International Data and Analysis.

lished. The code stated that all mining activities were bound by the rules incorporated in the code, which covered prospecting, exploitation, research permits, and concession rights. Mining concession rights were limited to 25 years, with two 10-year extensions possible thereafter. Exploitation permits were for 5 years with two successive extensions possible.

Nickel deposits with estimated reserves of about 200 million tons of ore containing over 1.5% nickel remained untapped during 1976. These deposits were located at Musongate, Nyabikere, and in a 30-kilometer zone between the towns of Rutana and Mahana in the southeastern section of Burundi. Apparently, metallurgical problems with the ore hindered plans for the development of this resource. Preliminary estimates put the required finances at $800 million for various types of investments before production could begin. The possibilities of recovering other minerals such as cobalt, copper, and perhaps platinum were discussed during the year. The U.S. entrepreneur Maurice Templesman remained the prime candidate to develop the nickel deposits of Burundi.

CAMEROON [14]

The mineral industry was a minor contributor to the economy of the Federal Republic of Cameroon, which in fiscal year 1976 balanced its budget at approximately $435 million.[15] Small amounts of cassiterite, cement, gold, limestone, and marble were produced from domestic sources. Aluminum was produced from imported alumina and cement from imported clinker. Aluminum and cement exports accounted for 6% of total exports in 1976. The country's first fertilizer complex at Bonabéri near Douala came onstream at yearend. The plant was to produce complex (nitrogen-phosphate-potash (NPK)) fertilizers, ammonium sulfate, and single superphosphate (20% P_2O_5).

During 1976, the Government in cooperation with Société d'Études des Bauxites du Cameroun (SEBACAM) actively sought financing from the World Bank, other potential aid donors, and private companies to assist in developing the bauxite deposits near the towns of Minam and Martap and at Ngaoundéré. The bauxite reserves in these deposits were estimated at 2 billion tons grading 44% Al_2O_3 at Minam and Martap and 39% Al_2O_3 at Ngaoundéré. The existence of large bauxite resources in north-central Cameroon had been known since 1958.

In 1969, SEBACAM, a partnership of the Government (40%), Péchiney Ugine Kuhlmann (PUK) (45%), Vereinigte Aluminium Werke (VAW) (10%), and Kaiser Aluminum & Chemical Corp. (5%), was formed to plan the exploitation of the bauxite deposits. During 1976, SEBACAM submitted the results of the completed study of the bauxite deposits and development plans to the Ministry of Economy and Plan. Undoubtedly, significant investments would be required for development owing to the remote location and lack of transport facilities.

The Canadian International Development Agency (CIDA) funded a mineral research survey that was conducted in southeastern Cameroon. Preliminary research indicated large reserves of iron ore (hematite) in a belt extending southward from Kribi to the Río Muni border. The survey also identified manganese, thorium, and uranium mineralization and indications of gold and diamond. The UNDP began further studies to delineate the extent of the resources discovered in the Canadian program.

BRGM has studied large copper deposits between Bibémi and Maroua in northern Cameroon. The lack of infrastructure and the low world copper price in 1976 prohibited their development.

Utah Development Co. conducted further studies on uranium deposits in northern Cameroon near Poli. The deposits discovered were not considered to be of sufficient size and concentration to justify large-scale exploitation, owing to infrastructure requirements.

The Government was cognizant of the need for improving the country's transportation system and planned to invest $640 million in infrastructure during 1977–81 under the fourth development plan. Expanding and modernizing the country's

[14] Prepared by David E. Morse, physical scientist, International Data and Analysis.

[15] Where necessary, values have been converted from CFAF to U.S. dollars at the rate of CFAF-230=US$1.00.

major port, Douala, was to be completed under the plan at a cost of $120 million.

During 1976, Essence et Lubrificants de France-Société de Recherches et d'Exploitation des Pétroles au Cameroun (Elf-Serepca) drilled seven oil wells in the offshore Rio-del-Rey permit. Elf-Serepca planned to begin developing the Kolé discovery in Rio-del-Rey beginning in 1977. Crude oil production was to reach 400,000 tons per year in 1978. Exploitation of the modest natural gas field (300 million cubic meters) at Logbaba, onshore near Douala, was delayed owing to the lack of industrial consumers. Cameroon planned to build a 1.5- to 2.0-million-ton-per-year oil refinery at Limboh Point near Victoria. Details of financing and the scheduled completion date of the oil refinery were not known.

Other companies holding petroleum exploration rights in Cameroon during 1976 were Ocean Exploration Co. Ltd. (OEC) (5,300 square miles), Gulf Oil Corp. (1,094 square miles), Mobil (723 square miles), Norwegian Oil Co. Ltd.'s subsidiary Normafrique (578 square miles), and Damson Oil Co. (496 square miles).

CAPE VERDE ISLANDS [16]

The Cape Verde Islands, an archipelago of volcanic islands in the Atlantic Ocean 500 kilometers west of Dakar, had no important mineral production in 1976. The nation remained in the grip of a prolonged drought, which has persisted since the late 1960's. The Government of the young nation (independence achieved in 1975) had begun implementing comprehensive land reclamation and water conservation schemes and had instituted a program to assess the country's water resources. The Islands' leaders applied for aid from the United Nations to alleviate the critical food shortage.

CENTRAL AFRICAN EMPIRE [17]

The diamond industry, the main foreign exchange earner of the country, continued its recent downward trend, with production of only 286,000 carats in 1976. This output was 15% below the 1975 level and a 50% drop from the peak years of the late 1960's. An increase in diamond export prices offset this decline and resulted in a slight increase in export value to $14 million, or 17% of total foreign exchange earnings. The cessation of operations in February 1976 by Société Centrafricaine d'Exploitation Diamantifere, a company that was mechanizing the mining and dredging operations, was a major reason for the decline of 1976 production. Since the top-level diamond-bearing strata had been skimmed away through years of exploitation, capital investment and mechanization were required to mine lower horizons.

The exploration and evaluation work of Société d'Uranium Centrafricaine (SUC) continued during the year. SUC was incorporated by the Government of the Central African Empire, the French Commissariat à l'Énergie Atomique (CEA), and Alusuisse of Switzerland in 1975. Owing to the uranium's high phosphorus content, Alusuisse designed a new separation method that made the deposit economically viable. Alusuisse was expected to expand its feasibility study and had earmarked $3 million to $4 million [18] for the 1978 investigation. The Bakouma uranium deposit, located about 100 kilometers north of Bangassou, contains 20,000 tons of measured reserves. The inaccessibility of the deposit seemed to be the biggest obstacle to development of the mine. Total planned investment was estimated at $300 million. When in full operation, the plant was to employ 1,500 local workers.

A new magnetic anomaly discovered in late 1975 remained unexplored, although preliminary studies suggested the existence of heavy metals deposits. The United Nations and the United States, through AID, were considering an aeromagnetic study and more detailed geologic studies of the area to establish the base for possible commercial exploitation.

[16] Prepared by David E. Morse.
[17] Prepared by E. Shekarchi.
[18] Where necessary, values have been converted from CFAF to U.S. dollars at the rate of CFAF226=US$1.00.

Shell and Continental Oil Co. (Conoco) of the United States performed aeromagnetic studies and a seismologic survey to delineate possible oil structure in the northern part of the country. No drilling was reported by yearend.

Other projects in the mineral sector were under consideration and awaited financing. These included a metallurgical works producing steel at the iron deposits of Bogoin and Bembi and a cement plant at the limestone deposits of Fatima.

CHAD [19]

The mineral industry of Chad remained very small in 1976. Natron (hydrous sodium carbonate, equivalent to trona), the only mineral exported, was extracted in rough blocks by native tribesmen from saliferous basins on the northeastern shores of Lake Chad. The blocks were dried in the sun, shaped to a convenient size (average 35 kilograms), and transported to N'Djaména by camel and barge for sale. Natron was used as a salt (NaCl) substitute for human and animal consumption, to preserve meat and hide, and in soap manufacture. The 1976 natron output was estimated at 8,000 tons. Clay for the N'Djaména brickworks, salt, sand and gravel, and stone were also produced for local consumption.

The UNDP began a mineral assistance project in Chad in 1973. The project began geologic studies in a 10,000-square-kliometer area in the Mayo-Kebbi region of southwestern Chad, provided training for the staff of Chad's Geologic Service, and established a geochemical laboratory within the Service. Activities of the project have yielded evidence of gold, nickel, uranium, and complex sulfide ores. The project also provided fellowships for training personnel outside of Chad. The project experienced an 18-month delay before implementation and in 1976 was extended an additional 16 months to the end of 1977. The Director of Mines and Geology stated the "availability" in Chad of 2.7 million tons of diatomite, 500,000 tons of kaolin, 6 million tons of limestone, 6 million tons of natron, and 25,000 tons of salt.

Conoco-Tchad continued to explore for oil in Chad during the year. Oil had been discovered by Conoco-Tchad in the Kanem Prefecture north of Lake Chad and in Logone Occidental near Doba in the south. The shows were considered sufficient to warrant further drilling in both areas. The Government planned to build a 1,500-barrel-per-day topping unit at N'Djaména. The unit would be supplied with Kanem crude oil and would provide a variety of refined products. The scope of the project was limited but would be sufficient to substantially reduce the nation's total reliance on imported petroleum products.

COMOROS [20]

The Republic of the Comoros, an archipelago of islands situated in the Mozambique Channel off the southeastern coast of Africa, proclaimed its independence from France in July 1975. The three main islands are Anjouan, Mohéli, and Great Comoro; a fourth island, Mayotte, remained an overseas territory of France. The agricultural sector has consistently been the major contributor to the country's economy; mineral resources remain largely unknown and unexplored. The country's primary trade partners were Madagascar, Tanzania, Kuwait, and Saudi Arabia. In 1975–76, most major industries were nationalized, including the largest oil distributor, Royal Dutch/Shell. Petroleum products were supplied by Madagascar in 1976.

In December 1975, France terminated all economic aid (which previously amounted to $18 million [21] per year) and repatriated all French officials and technicians from the Comoros. The country's austerity budget was supplemented by foreign loans and grants. In 1976, the Comoros received $10 million in aid from the Arab Fund for Loans to African Countries. Other financial aid included $6 million from the Kuwaiti Fund for Arab Economic Development, $1 million from Libya, and $10 million from the Saudi Arabian Development Fund for

[19] Prepared by David E. Morse.
[20] Prepared by Candice Stevens.
[21] Where necessary, values have been converted from CFAF to U.S. dollars at the rate of CFAF242=US$1.00.

infrastructure development. In addition, a technical and economic cooperation agreement was concluded with the People's Republic of China during 1976.

CONGO [22]

The mineral sector, dominated by the petroleum industry, continued to be a major contributor to the economy of the People's Republic of the Congo in 1976. An increase in oil tax and royalty rates was to raise the country's budget from $240 million [23] in 1976 to $254 million in 1977. Apart from the petroleum industry, the main mineral producers were the Holle potash mines at Pointe Noire and the Mpassa copper-lead-zinc mines. Both, however, suffered from mining problems in 1976, specifically, geological irregularities in the potash seam at Holle and difficulties in pillar recovery in copper production at Mpassa. The Congo also produced small amounts of natural gas, gold, and cement.

In December 1976, the Government created Société Nationale des Recherches et d'Exploitations Minières (SONAMINES) to manage and consolidate the Congo's mine and quarry operations. SONAMINES was to supervise the exploration and exploitation of all Congolese minerals and would assume the operations of Hydro-Congo, the national petroleum company, and all other mining firms. Among the projects to be transferred to SONAMINES were prospecting for uranium in the northwest near Gabon; evaluation of iron ore deposits (estimated at 304 million tons) in the Bambama, Sembé, and Mayouka Basins; and development of phosphate deposits in the lower Tchivoula and Loufica areas. In January 1976, a joint Bulgarian-Congolese company, Société des Phosphates de Congo (SOPHOSCO), was formed to exploit the deposits; production was scheduled to reach 2 million tons of phosphate per year.

The major project under the current 3-year plan (1975–77), the realignment of the Congo Ocean Railroad (CFCO), continued on schedule. Under the supervision of L'Agence Transcongolaise des Communications, the modernized railroad between Brazzaville and Pointe Noire would facilitate transport of exports from Cameroon, Chad, Gabon, and the Central African Empire. The $234 million project was to be partially financed through loans from the European Economic Community (EEC), the ADB, and the Arab Bank for Economic Development in Africa. In 1976, the IBRD approved a $38 million loan to purchase railroad equipment and increase the capacity of the port of Pointe Noire.

Petroleum production in the Congo increased 6% from 36,877 barrels per day in 1975 to 39,107 barrels per day in 1976. In 1976, the Congolese Government negotiated increased tax and royalty rates with its two producing companies. Elf-Congo (a subsidiary of France's State-owned Essence et Lubrificants de France-Entreprise de Recherches et d'Activités Pétrolières S.A. (Elf-Erap)) and Agip (a subsidiary of Italy's Ente Nazionale Idrocarburi (ENI)). As of October 11, 1976, Government revenue per barrel of petroleum was $5.49.

The greater part of production was from the Emeraude Field, owned 35% by Elf-Congo and 65% by Agip. The 1969 offshore discovery was expected to produce 100,000 barrels per day but failed to reach its goal despite continued drilling. The smaller Pointe Indienne Field produced an average of 192 barrels per day in 1976 and was scheduled to cease production in 1980.

Startup at the Loango Field, owned in equal shares by Elf-Congo and Agip, was delayed until late 1977. Fourteen wells were to be drilled from three platforms with ultimate output averaging between 40,000 and 50,000 barrels per day. A 97-kilometer, 18-inch pipeline was to link the Loango Field with the Djeno terminal, which also handled Emeraude crude. Elf-Congo and Agip also began development drilling at their other joint discovery, the Emeraude Sud Field, scheduled to begin production in 1978.

Both Elf-Congo and Agip continued exploration in their concession areas in 1976. Another consortium, Seagap, conducted seismic and magnetometer surveys in its 8,000-square-kilometer Mer Profonde permit area. Members of the group included Getty Oil Co. as operator, Agip, Phillips Petroleum Co., and Hispanoil.

Construction of the Congo's first petroleum refinery neared completion at Pointe

[22] Prepared by Candice Stevens.

[23] Where necessary, values have been converted from CFAF to U.S. dollars at the rate of CFAF242=US$1.00.

Noire. The refinery, which was to have an annual capacity of 1 million tons, would be supplied entirely by the Emeraude Field.

The Congo's natural gas production, derived from the Pointe Indienne Field, was used in the Holle potash plant. Marketed natural gas production decreased from 1.6 million cubic feet per day in 1975 to 1.48 million cubic feet per day in 1976.

Production of potash at the Holle mine, located 45 kilometers northeast of Pointe Noire, fell from 280,106 tons of K_2O in 1975 to 256,521 tons of K_2O in 1976. The mine was operated by Compagnie des Potasses du Congo (CPC), formed in 1964 to exploit the lenticular bed of sylvanite with a potash content of more than 35%. The lens covered an area of 9 square kilometers with an average thickness of 2.7 meters and an average depth of 370 meters. Reserves were estimated at several billion tons. However, technical difficulties at Holle, aggravated by a fall in the price of potash in 1976, kept output below anticipated levels.

During the year, the French partners in CPC continued negotiations with the Congolese Government for a withdrawal of shares. Interests in CPC were held by the Congolese Government (15%), Entreprise Minière et Chimique (36.125%), BRGM (36.125%), and Elf-Erap (12.75%). A statement of accord was concluded in November which envisaged the transfer of CPC to the Congolese State. France agreed to bear the cost of loan repayments and would guarantee markets for a quantity of minerals equivalent to 1 year's production. However, no final decision was made on these terms at yearend.

Other investigations have focused on the exploitation of carnallite deposits in the immediate vicinity of the existing mine at Holle. A consulting firm established with French and West German partners initiated a $6 million feasibility study in 1976. Previous work indicated that the carnallite horizon occurs as a thick regular bed unaffected by folding and could support an operation of 1 million tons of potash per year.

Production of copper, lead, and zinc concentrates by Société Minière de Mpassa was reported to have declined slightly in 1976. Copper concentrate production in 1975 was 2,181 tons grading 37.6% copper, 9.1% zinc, and 2.06% lead. Lead-zinc concentrate production in 1975 was 13,272 tons grading 2.7% copper, 37.2% zinc, 14.7% lead, and 7.5% iron.

Société Nationale des Mines de Mfouati (SONAMIF) continued development of its new base metal mining and milling facilities in the Boko Songo area, located 250 kilometers west of Brazzaville. Geological teams from the U.S.S.R. have been investigating these and other deposits in the area for a number of years and have located sufficient reserves to support a commercial mining operation. Ore reserves at Djenguilé were estimated at 300,000 tons averaging 28% lead, 9% zinc, and 4% copper. The U.S.S.R. financed the construction of a concentrator having an annual capacity of 30,000 tons of lead concentrate and 4,000 tons of copper concentrate. Startup was scheduled for 1978.

Production of gold by small independent producers in the Congo fell from 5,281 troy ounces in 1975 to approximately 5,000 troy ounces in 1976. Société Nationale des Mines de Soundi-Kakamoéka (SONAMIS), a joint venture of the Congo and the U.S.S.R., continued development of gold deposits in the Kouilou region north of Pointe Noire. Reserves at the alluvial gold deposits were estimated at 144,678 troy ounces.

Cimenterie de Loutété (CIDOULOU) continued the expansion of its cement plant from 100,000 tons to 300,000 tons per year. A clinker-grinding plant was inaugurated at Madingou with a 10,000-ton-per-year capacity. A brick company, Congobric, was established in 1976 to construct a new brick fabrication plant.

EQUATORIAL GUINEA [24]

The economy of Equatorial Guinea continued to be based on agriculture and timber in 1976. There were no changes in the oil concessions around Isla de Macias Nguema Biyogo (formerly Fernando Po) or off Río Muni Province on the mainland, nor was exploratory activity reported. Local building materials were probably utilized, but there was no indication that previously reported deposits of phosphate, iron ore, or radioactive materials were investigated or exploited during 1976. Political conditions

[24] Prepared by Miller W. Ellis, physical scientist, International Data and Analysis.

reportedly caused an increased rate of emigration of skilled expatriates from Equatorial Guinea, including some 40,000 Nigerian nationals.

ETHIOPIA [25]

The mineral sector was a minor contributor in 1976 to the economy of Ethiopia, rated by the United Nations as one of the world's 10 poorest countries. Although the country's mineral potential was believed to be excellent, it remained undeveloped except for small gold, platinum, and salt operations. Cement manufacture and refining of imported crude oil were the other major mineral activities. The Ethiopian Provisional Military Government (EPMG), which nationalized major industries and financial institutions in 1975, established State corporations in 1976 to consolidate and manage its holdings. Compensation for the nationalized companies, both foreign and domestic, was to be arbitrated by a new compensation commission. The Government required 51% ownership in all new ventures except mineral exploration and exploitation. In 1976, the EPMG budgeted a deficit of $170 million [26] for 1977 to finance development projects.

Ethiopia concluded many new technical and financial assistance agreements during the year. Soviet geological teams made a brief survey of Ethiopian mineral resources, after which Ethiopia and the U.S.S.R. signed protocols on economic and technical cooperation. The future Soviet aid commitment was estimated at $100 million. In November 1976, Ethiopia concluded scientific and technical cooperation agreements with Czechoslovakia and North Korea. Total economic assistance from the United States, traditionally Ethiopia's major economic and military supplier, was $18.6 million in 1976.

The People's Republic of China was to finance eight diesel powerplants in Ethiopia at a total cost of $12 million. In December 1976, the first 190-kilowatt plant was inaugurated at Fiche in Gojām Province. Ethiopia remained relatively unaffected by the energy crisis because two-thirds of the country's power needs are supplied by a large network of hydropower-generating facilities, with a potential for much greater future production.

Exploration and mineral assessments proceeded in 1976, primarily in Wollega Province in the western part of the country. Exploration for copper was conducted in the Kotta area of Wollega Province. After preliminary drilling, large geothermal resources in the middle and lower Awāsh Valley were scheduled for further assessment. Exploration for phosphate and radioactive minerals in Ogaden also yielded positive results but was discontinued owing to conflict in the region.

In 1976, Ethio-Nippon Mining Co., Ltd., of Japan liquidated its assets in the Debarwa copper mine and relinquished its concessionary rights. The Debarwa venture, which was originally envisaged as a 5,000-ton-per-month operation, was brought to a standstill only a few months after startup in 1974 owing to insurgent action. Located south of Asmara in Eritrea Province, the deposit was estimated to contain 600,000 tons of ore grading 8% copper. The Adi Nefas deposit, situated 10 kilometers east of Asmara, also contained substantial reserves. Only 2,000 tons of copper was exported to Japan prior to the halt in operations.

The output of the Government-owned Adola goldfields decreased to approximately 11,253 troy ounces in 1976 compared with 19,981 troy ounces in 1975. Gold from the Adola alluvial deposits, situated in Sidāmo Province in southern Ethiopia, was recovered by traditional hand methods. In 1976, exploration at the Sirgole placer gold prospect in western Wollega Province continued at a somewhat slower pace; studies were conducted to determine the most appropriate mining method—manual, semimechanized, or dredging. The Government planned to triple gold production from the Provinces of Wollega and Sidāmo.

A small amount of platinum was produced at the Government mine at Yubdo in Wollega Province. A test pitting program was undertaken in 1976 in both the eluvial and associated alluvial deposits to produce reliable reserve estimates.

Production at Ethiopia's two cement plants totaled 148,500 tons in 1976. The

[25] Prepared by Candice Stevens.

[26] Where necessary, values have been converted from Ethiopian birr (B) to U.S. dollars at the rate of B2.09=US$1.00.

Eritrea Cement Co. plant at Massawa in Eritrea ceased operations for 2 months in early 1976 but later resumed activities. Rated capacity of the Massawa facility, opened in 1966, was 70,000 tons per year. The Addis Ababa cement plant, operated by Ethiopian Cement Corp., had an 80,000-ton-per-year capacity. Clay and limestone were quarried in Mugar Valley, located about 45 kilometers north of Addis Ababa, for production of portland cement. Approximately 8,500 tons of limestone was quarried in 1976. Additional large reserves of glass sand and limestone in Mugar Valley were under development for use in the local glass and cement factories.

Marine salt output from solar pans along the Red Sea declined to 88,000 tons in 1976. The two major saltworks in Eritrea each had a rated capacity of 100,000 tons per year. Production of Societa Saline di Massawa and Société des Salines d'Assab was mostly for export.

The route to Ethiopia's sole petroleum refinery at Assab in Eritrea was kept open, and the plant maintained a production level of approximately 4 million barrels of petroleum products in 1976. Constructed with Soviet assistance in 1967, the 14,000-barrel-per-day refinery was owned and operated by Ethiopian Petroleum Share Co. It supplied most of the country's gas and oil needs except for specialty fuels, which were imported. All crude oil was imported from Saudi Arabia. Gas rationing continued in 1976 owing to the internal security situation. The four petroleum-distributing companies—Mobil Oil East Africa Ltd., Shell, Agip, and Total—were 51% owned by the Government.

Political uncertainty in Ethiopia caused all petroleum exploration activity to cease in 1976. The Whitestone International/Louisiana Land & Exploration Co. joint venture relinquished its 100,000-square-kilometer concession in northern Ogaden during the year. Royal Dutch/Shell relinquished its 27,000-square-kilometer concession along the Eritrean coast after drilling an unsuccessful well 20 kilometers off Assab in the Red Sea. At yearend, no oil concessions were held by foreign firms.

Table 2.—Ethiopia: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Copper matte	1,900	--
Iron and steel metal:		
Scrap	NA	5
Semimanufactures	NA	724
Other: Ash and residue containing nonferrous metals	46	--
NONMETALS		
Cement	NA	3,116
Clays and clay products (including all refractory brick)	NA	521
Salt and brine ---value, thousands--	$114	$2,354
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	NA	791
Worked	NA	1
Sand, excluding metal bearing	NA	72
Other:		
Crude	--	18
Slag, dross, and similar waste, not metal bearing	NA	153
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	NA	597
MINERAL FUELS AND RELATED MATERIALS		
Carbon black and gas carbon	NA	39
Coal	NA	333
Gas, hydrocarbon, manufactured ---value, thousands--	NA	$9
Petroleum refinery products:		
Distillate fuel oil ---do---	NA	$9,889
Lubricants ---do---	NA	$19
Mineral jelly and wax ---do---	NA	$13

NA Not available.

Table 3.—Ethiopia: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, all forms	548	448
Arsenic trioxide, pentoxide, acids	NA	7
Copper:		
Copper sulfate	2,123	2,135
Metal including alloys, unwrought and semimanufactures	126	142
Iron and steel metal:		
Scrap	NA	495
Pig iron, including cast iron	60	61
Steel, primary forms	2,504	2,337
Semimanufactures:		
Bars, rods, angles, shapes, sections	8,284	2,076
Universals, plates, sheets	15,692	16,464
Hoop and strip	196	11
Rails and accessories	--	726
Wire	509	41
Tubes, pipes, fittings	5,359	4,059
Lead metal including alloys, all forms	104	20
Manganese oxides	200	--
Nickel metal including alloys, all forms	6	5
Tin metal including alloys, all forms	8	39
Titanium oxides	31	15
Zinc:		
Oxide	NA	50
Metal including alloys, all forms	65	363
NONMETALS		
Abrasives, natural, n.e.s	982	57
Cement	348	596
Chalk	NA	6
Clays and clay products(including all refractory brick):		
Crude	1,341	20
Products	3,205	712
Fertilizer materials:		
Crude, phosphatic	NA	13,850
Manufactured:		
Nitrogenous	2,729	5,273
Other	6,005	11,975
Ammonia	NA	1
Graphite, natural	NA	73
Pigments, mineral:		
Natural, crude	NA	10
Iron oxides, processed	NA	39
Salt and brine	NA	325
Sodium and potassium compounds, n.e.s.:		
Caustic soda	4,347	2,771
Caustic potash and sodic and potassic peroxides	NA	70
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	NA	11
Worked	NA	(1)
Sand, excluding metal bearing	NA	5
Sulfur:		
Elemental, all forms	1,053	164
Sulfuric acid ---value, thousands	$40	$109
Talc	NA	5
Other:		
Crude	1,436	64
Oxides and hydroxides of magnesium, strontium, barium	NA	1
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s ---value, thousands	$26	$226
MINERAL FUELS AND RELATED MATERIALS		
Carbon black	859	152
Coal and coke, including briquets	10,012	79
Gas, hydrocarbon, manufactured	NA	10
Petroleum:		
Crude ---thousand 42-gallon barrels	NA	3,810
Refinery products:		
Gasoline ---do	NA	6
Kerosine ---do	60	27
Jet fuel ---do	NA	52
Distillate fuel oil ---do	NA	39

See footnotes at end of table.

Table 3.—Ethiopia: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity		1974	1975
MINERAL FUELS AND RELATED MATERIALS—Continued			
Petroleum—Continued			
Refinery products—Continued			
Residual fuel oil	thousand 42-gallon barrels	NA	4
Lubricants	do	30	8
Other:			
Liquefied petroleum gas	do	NA	4
Mineral jelly and wax	do	3	43
Nonlubricating oils, n.e.s	do	1	6
Bituminous mixtures, n.e.s	do	1	(1)
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		NA	17

NA Not available.
[1] Less than ½ unit.

THE GAMBIA [27]

The Gambia, a small western African republic surrounded by Senegal except along the Atlantic coastline, had a GDP of approximately $94 million [28] and negligible mineral production in 1976. The only known significant mineral deposits in the Gambia were heavy beach sands near Brufut and Sanyang in the Western Division and kaolin in the Upper River Division. Production of unrecorded small amounts of clay, stone, and sand and gravel undoubtedly took place.

The Gambia Basin Development Organization, a Gambia-Senegal cooperative, planned to construct two hydroelectric dams on the Gambia River. The proposed dam near Mansa Konko would include a toll causeway that would provide revenue for the Gambia and significantly increase communication between northern Senegal and the Casamance region of Senegal to the south of the Gambia. The dam would also limit the extent of saltwater in the river to areas below the dam, thereby increasing the amount of freshwater available for irrigation.

Geologic investigations indicated that the ilmenite, zircon, and rutile beach sand deposits in the Western Division are of a grade and quantity sufficient to justify commercial production. The Government planned to have a nationwide survey conducted to establish the existence of any other similar deposits.

The Gambia depended on imports to supply its needs of cement, fertilizer, iron and steel, and petroleum products. The Government planned to build a 1-million-ton-per-year petroleum refinery near Banjul with assistance from Middle Eastern petroleum producers.

GUINEA [29]

Guinea, a small western African nation of 4.2 million people, is well endowed with mineral resources. It has over one-fourth of the world's known high-quality bauxite reserves, 12 billion tons of iron ore, a significant but untapped diamond reserve, alluvial gold, uranium, and indications of petroleum.

During 1976, nearly all of the mineral industry of Guinea was based on the production of bauxite. The output of 10.8 million tons was 29% higher than that of 1975 and represented 14% of total 1976 world output. Alumina production during the year was 560,000 tons. Bauxite and alumina production contributed over 30% to the gross national product (GNP) and provided 80% of foreign exchange earnings. Three bauxite mines were in operation in 1976.

The Sangaredi open pit bauxite mine in northwestern Guinea, which began shipping ore in 1973, produced over 6.5 million tons in 1976 and was to produce 9 million tons per year by 1980. The mine was operated by Compagnie des Bauxites de Guinée (CBG), a consortium of aluminum producers (51%) and the Government (49%).

[27] Prepared by David E. Morse.
[28] Where necessary, values have been converted from Gambian delasis (D) to U.S. dollars at the rate of D1=US$0.4423.
[29] Prepared by David E. Morse.

The Sangaredi deposit contained over 180 million tons of bauxite grading 58% alumina, with no overburden and a minimum of waste inclusions.

In 1976, Office des Bauxites de Kindia (OBK) produced about 2.5 million tons of bauxite with an average alumina content of 46% from the Débélé deposits located 135 kilometers northeast of Conakry. The Government-owned operation began production in 1974 and was initiated with technical assistance and financing by the U.S.S.R. All of the production was exported to the U.S.S.R. during the year.

The third bauxite producer, Société d'Economie Mixte Friguia, mined over 1.8 million tons for production of alumina. The production capacity of the alumina plant was 700,000 tons per year, and the output was 560,000 tons during 1976. Friguia was owned 49% by the Government and 51% by FRIA Compagnie Internationale pour la Production de l'Alumine (Frialco), a consortium of large world aluminum producers. Friguia was studying plans to expand the capacity of the alumina plant to 1.3 million tons per year.

On July 27, Société Guinea-Arabe d'Alumine et d'Aluminum (Alugui) was established in Tripoli, Libya, at a capital cost of $2.4 billion, one-half of the capital attributed to the Guinea Government for the land allocation and mining titles. The other partners were Libya, Egypt, Kuwait, Saudi Arabia, and the United Arab Emirates. Alugui was to exploit bauxite deposits at Ayékoyé near Boké in northwestern Guinea, producing 2.1 million tons of alumina per year for export and eventually producing 150,000 tons of aluminum per year. Alusuisse was to conduct detailed exploration and feasibility studies and make preliminary designs.

Other bauxite deposits have been studied at Tougué and nearby at Dabola. Alusuisse investigated the 2,500-million-ton bauxite deposits at Tougué, and experts from Yugoslavia conducted studies on the 450-million-ton Dabola deposits. Still in the preliminary stages, an immense undertaking was planned to exploit these deposits to produce 13 million tons of bauxite and 1 million tons of alumina per year. The project would be served by a branch line to the old (1910) colonial Conakry-Kankan railroad, which was to be significantly modernized to handle increased heavy traffic.

During 1976, the major importers of Guinea bauxite were the United States (3 million tons), the U.S.S.R. (2.4 million tons), Canada (1.3 million tons), West Germany (1.2 million tons), and France (0.69 million tons). Most of the alumina produced by Friguia was exported to France and Cameroon.

Two extensive iron ore deposits were located in southeastern Guinea near the Liberian border at Mount Nimba and Mount Simandou. The Mount Nimba deposit has been studied by Swedish experts and reportedly contains over 600 million tons of hematite grading 69% iron and 2 billion tons of lower grade ore. In 1973, Société des Mines de Fer de Guiné-Nimba (Mifergui-Nimba) was set up to develop the Mount Nimba deposit. The company planned to produce 2 million tons per year from an open pit operation in 1980–81 and to expand to 15 million tons per year after the third year of operations. A 17-kilometer railroad spur connection will be built to the Liberian rail system for export of iron ore from Buchanan, Liberia. Mifergui-Nimba was owned by the Government (50%) and a group of foreign private and governmental interests (50%). In 1976, two large French steel companies purchased interests in Mifergui-Nimba, and Kaiser Engineers and Constructors, Inc., was appointed to conduct feasibility and mine-mill planning studies. The development of the Mount Simandou deposit contingent on the success of the Mount Nimba project.

In 1976, Compagnie Française des Pétroles (CFP) decided to participate in Société de Guinée des Pétroles (Soguip). After CFP acquired an interest, Soguip was owned 49% by the Government, 17.8% by Buttes Gas and Oil Co. (United States), 10.2% by Naftagas (Yugoslavia), 17.85% by CFP/Agip, and 5.1% by Japan Petroleum Development Corp. Soguip planned to conduct exploratory drilling operations in a 44,000-square-kilometer offshore block in early 1977.

GUINEA BISSAU [30]

Guinea Bissau, a small western African nation of about 800,000 people, had no important mineral production in 1976. Small amounts of sand and gravel, stone, and marine salt were produced for local consumption. The country was largely dependent on imports to supply its energy requirements. Resources of bauxite, gold, iron ore, phosphate rock, and zircon have been reported but remained undeveloped in 1976. Oil exploration had been conducted on Guinea Bissau's Atlantic continental shelf, but because of uncertainties in the Government's position concerning concessions, no activity took place during 1976.

Guinea Bissau and the U.S.S.R. signed an agreement to study the bauxite deposits in the Boe region of west-central Guinea Bissau near Lugajol, adjacent to the border with Guinea. The U.S.S.R. was to conduct a 2-year study delineating the extent and grade of the bauxite deposits. During 1975, 48 test drillings were completed in the area, and reserves of bauxite were estimated to be 500 million tons. In the late 1950's, N.V. Billiton Maatschappij of the Netherlands had determined bauxite reserves of 120 million tons including 24 million tons tested at 47% Al_2O_3. Commercial development of the Boe deposits was not expected in the near future, owing to their remote location and the lack of transport facilities.

IVORY COAST [31]

Following a difficult year in 1975, characterized by fluctuating commodity prices and a lack of demand for timber, the Ivory Coast had an excellent year in 1976. The new 5-year development plan (1976–80) presented by the Government envisaged a diversified economy, massive new investment in infrastructure, export-oriented industry, and improved mining of the substantial Mount Klahoyo iron ore deposits. A large portion of the required investment for the iron ore plant required capital investment from abroad.

Société pour le Developpement Minière de la Cote d'Ivoire (Sodemi), the Ivorian State prospecting company, conducted geological and geochemical prospecting during the year. The main targets of Sodemi's studies were cassiterite west of the Kafiné region, gold in the Lôho River Basin, and molybdenum and copper at Dyengélé.

The GDP grew at current prices from $3.4 billion in 1975 to $4.4 billion in 1976.[32] Per capita GDP increased from $510 in 1975 to $623 in 1976.

In December 1975, Société Watson became the sole diamond producer. During 1976, the company mined from its alluvial deposits near Séguéla and processed about 282,000 cubic meters of ore to produce about 60,000 carats, compared with 289,000 cubic meters and 75,000 carats in 1975. Exports of diamond decreased to about 338,413 carats in 1976, compared with 1,039,810 carats in 1975. Crude petroleum cost the country about $100 million in 1976, but the Ivory Coast recovered about one-half that amount by exporting refined products to Upper Volta and eastern Mali. Société Ivoirienne de Raffinage (SIR) processed 1.7 million tons of crude oil in 1976, most of which was imported from Nigeria, with a small portion originating in Middle Eastern countries. The Government's expansion plans called for a twofold increase in refining capacity and an asphalt production plant that would use Venezuelan petroleum and would supply the needs of the highway improvement program.

Energy production barely kept up with demand. More than 1 billion kilowatt-hours of electricity was generated during 1976, and more hydraulic energy production was planned for the future. The search for oil offshore continued during the year. Esso Exploration Inc. drilled a total of 11 wells during 1975 and 1976 and found encouraging signs of petroleum. The company planned further drilling for 1977. The consortium of Phillips/Hispanoil/Getty/Agip completed its seismic studies and brought the *Discoverer Seven Seas* drillship to the Ivory Coast to drill one hole in 1977.

The iron ore deposits found in the mountainous area 600 kilometers northwest of Abidjan remained dormant in 1976. A consortium consisting of British Steel Corp.

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[30] Prepared by David E. Morse.
[31] Prepared by E. Shekarchi.
[32] Where necessary, values have been converted from CFAF to U.S. dollars at the rate of CFAF226=US$1.00.

20%, Mitsubishi Shoji Kaisha 20%, Pickands Mather & Co. 15%, Union Sidérurgique du Nord et de l'Est de la France S.A. (USINOR) 10%, Hoogovens IJmuiden B.V. 10%, and Sodemi 5%, which was organized in 1974, delayed construction of an iron pelletization plant for another year because of the projected sluggish conditions in the world steel market and the high cost of mining infrastructure.

Installation of a third clinker grinder increased cement production to 768,000 tons in 1976. Further improvements and expansion of the Abidjan cement plant to a capacity of 650,000 tons per year by 1980 were projected. Beton-Ivoire approved the establishment in the Branco Nord region of a concrete piping production unit for the domestic market.

Gold deposits at Ity, 60 kilometers west of Man, remained undeveloped. However, a consortium was established in 1976 for its exploitation. The consortium intended early development of the mine owing to high prices for gold in the world market. Falconbridge Nickel Mines Ltd. of Canada was discussing possible financing for development of the nickel deposits in the western part of the Ivory Coast, where a mineralized zone ranging in thickness from 5 to 6 meters was reported in an area of 21 square kilometers.

Table 4.—Ivory Coast: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975	1976
METALS			
Aluminum metal including alloys, all forms:			
Scrap		6	--
Semimanufactures		1,022	1,317
Copper metal including alloys, all forms		655	629
Iron and steel metal:			
Scrap		25,028	17,576
Semimanufactures including alloys, all forms		1,042	939
Lead metal including alloys, all forms		325	435
Zinc:			
Oxide		2	--
Metal:			
Scrap		233	395
Semimanufactures		252	(1)
Other:			
Ores and concentrates		2	(1)
Oxides, hydroxides, peroxides of metals, n.e.s		245	16
NONMETALS			
Abrasives:			
Pumice, emery, natural corundum, etc		(1)	70
Dust and powder of precious and semiprecious stones	kilograms	11	3
Grinding and polishing wheels and stones		3	1
Cement		118,186	97,312
Chalk		4	2
Clays and clay products:			
Crude:			
Bentonite		3	25
Other		25	5
Products, refractory		--	3
Diamond:			
Industrial	carats	549,075	222,863
Gem	do	490,735	115,550
Fertilizers and fertilizer materials, crude and manufactured		6,145	16,388
Gypsum and plasters		1,026	67
Lime		101	180
Pigments, mineral:			
Natural, crude		1	2
Iron oxides, processed		6	--
Salt		538	259
Sodium and potassium compounds:			
Caustic soda		20	127
Caustic potash		1	1
Stone, sand and gravel		135	3
Sulfur:			
Elemental		--	160
Sulfuric acid		37	49
Talc		(1)	21
Other, crude		4	2
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		14	69
Coal and coke, including briquets		8	(1)
Peat, including briquets and litter		(1)	--
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	(1)	(1)
Refinery products:			
Gasoline	do	598	626
Jet fuel and kerosine	do	108	96
Distillate fuel oil	do	834	768
Residual fuel oil	do	1,588	1,896
Lubricants	do	88	93
Other:			
Liquefied petroleum gas	do	29	11
Unspecified	do	2	1
Total	do	3,247	3,491
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		10	8

[1] Less than ½ unit.

Table 5.—Ivory Coast: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1975	1976
METALS		
Aluminum metal including alloys, all forms	7,302	9,833
Chromium oxide and hydroxide	5	7
Copper:		
Matte	(1)	8
Metal including alloys, all forms	239	594
Iron and steel metal:		
Scrap	71	253
Sponge iron, powder, shot	10	70
Ferroalloys:		
Ferromanganese	8	10
Other	5	2
Steel, primary forms	8,076	10,858
Semimanufactures	58,653	117,788
Lead:		
Oxides	73	323
Metal including alloys, all forms	123	272
Magnesium metal including alloys, all forms	8	(1)
Manganese:		
Ore and concentrate	497	720
Oxides	536	996
Mercury ---76-pound flasks	7	18
Nickel metal including alloys, all forms	1	23
Platinum-group metals including alloys, all forms ---troy ounces	32	162
Silver metal including alloys, all forms ---do	155,529	203,450
Tin:		
Oxides	5	(1)
Metal including alloys, all forms	10	34
Titanium:		
Ore and concentrate	40	11
Oxides	r 235	285
Zinc:		
Oxide	50	94
Metal including alloys, all forms	741	2,414
Other:		
Ores and concentrates	(1)	3
Ash and residue containing nonferrous metals	538	--
Oxides, hydroxides, peroxides of metals, n.e.s	1,944	22
Metals including alloys, all forms	3	1
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	103	31
Grinding and polishing wheels and stones	81	87
Asbestos	2	6
Barite	90	106
Boron materials, crude natural borates	610	451
Cement	693,666	754,071
Chalk	1,404	2,727
Clays:		
Bentonite	53	371
Kaolin	51	120
Other	43	212
Diamond, all grades ---carats	161	--
Diatomite	257	375
Feldspar	253	10
Fertilizer materials:		
Crude, phosphatic	6,897	1,584
Manufactured	19,706	69,514
Ammonia	8,766	3,189
Gypsum and plasters	39,125	44,832
Kieserite	3,445	5,150
Lime	4,759	5,032
Magnesite	3	25
Pigments, mineral:		
Natural, crude	135	159
Iron oxides, processed	70	183
Salt	32,920	30,716
Sodium and potassium compounds, n.e.s	6,183	10,295
Stone, sand and gravel	7,554	10,817
Sulfur:		
Elemental, all forms	8,017	5,363
Sulfuric acid	107	90
Talc	718	879
Other, crude	r 227	11

See footnotes at end of table.

Table 5.—Ivory Coast: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity		1975	1976
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		11	69
Coal and coke, including briquets		145	194
Hydrogen, helium, rare gases		3	2
Peat		16	59
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	10,851	11,234
Refinery products:			
Gasoline	do	21	82
Distillate fuel oil	do	(1)	175
Residual fuel oil	do	(1)	36
Lubricants	do	196	204
Other:			
Bitumen	do	125	174
Unspecified	do	35	40
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		r 599	760

r Revised.
1 Less than ½ unit.

LESOTHO [33]

Diamond continued to be Lesotho's only reported mineral commodity, and output in 1976 was twice that recorded for 1975. Lesotho diamonds were reported as gems only if they were individual stones valued at $230[34] or above. Lesotho diamond reported as industrial may have included small stones of gem quality. The average selling price for Lesotho's gem diamonds was about $375 per carat. All diamond was produced by local diggers, and all was recorded as exported with a total value of about $422,000. Lesotho's foreign exchange earnings of about $90 million were derived from the South African Customs Union and from remittances on behalf of some 120,000 Basotho nationals employed in the Republic of South Africa.

At the Letseng-la-Terai diamond deposit high in the Maluti Mountains of northeastern Lesotho, De Beers Lesotho Mining Co. (Pty.) Ltd. completed all housing and surface installations and an all-weather road for all-wheel-drive vehicles despite high winds and subfreezing temperatures during midyear. Pilot plant activity continued, and most sections of the full-scale plant were being tested at yearend. Systematic mining of the main K6 kimberlite ore body commenced in May. Soft weathered kimberlite was encountered to a depth of 15 meters, and preproduction mining was completed in the underlying hard kimberlite. A total of 500,000 tons of diamondiferous kimberlite was excavated and stockpiled; 300,000 tons of overburden gravel was saved for future sampling; and 250,000 tons of basalt and subeconomic kimberlite was stripped and dumped. Nearly 24,000 tons of kimberlite samples were recovered from 920 meters of development workings at the 55-meter level of a satellite deposit near the K6 ore body. Treatment plant testing was scheduled for early 1977, and full-scale production of 4,000 tons of ore per day was anticipated by mid-1977. The power supply line was supplemented by a new 88,000-volt line that was connected in August with the Lesotho Electricity Corp. power system. Adequate water was provided by a 7-kilometer, 4-pumping-stage pipeline from the Khebelu River. The cost of the new mine was estimated at about $38 million, and about 560 Basotho nationals and 100 expatriates were to be employed. The Lesotho Government holds a full 25% interest in the project and has rights to a higher percentage participation in the profits after De Beers has recovered its capital investment.

The UNDP cooperative project with Lesotho National Development Corp. and the Department of Mines and Geology reported the discovery of a large kimberlite pipe 6 kilometers east of Maseru as a result

[33] Prepared by Miller W. Ellis.
[34] Lesotho was a member of the South African Monetary Union. Where necessary, values have been converted from South African rand (R) to U.S. dollars at the rate of R1=US$1.15.

of field investigation of an aeromagnetic anomaly recorded during geophysical surveys by Canadian firms. Bulk sampling was started to determine the diamond content of the deposit. Bulk sampling of the previously known Kolo pipe was also planned to determine the potential of one of two kimberlite types found to contain possibly economic quantities of diamond.

Crushed stone, sand, and clay were produced for domestic construction purposes. Agate and other semiprecious stones were mentioned in reports, but no production statistics were available.

MALAWI [35]

The mineral industry of Malawi was a minor contributor to the nation's economy in 1976. Mineral production consisted primarily of cement, dolomite, agates, kyanite, and small amounts of sand and gravel and stone for domestic use. Mineral exploration continued on a fairly high level during the year. The Geologic Survey of Malawi was contracted to drill a carbonate deposit east of Kasungu for Portland Cement Co. (Malawi) Ltd. The deposit would be exploited to meet the needs of a new cement plant to be built in the Central Region. The Malawi Mineral Development Section of the Chamber of Mines of the Republic of South Africa completed field investigations at the Ngana coalfield northwest of Karonga and at the Chisepo iron sulfide deposit 50 kilometers northwest of Lilongwe; it also selected two areas in the Southern Region for exploratory drilling in the search for commercial apatite deposits. Eland Exploration (Pty.) Ltd. drilled a borehole at the Thuma zinc prospect 50 kilometers east of Lilongwe and two exloratory holes to investigate the geochemical-geophysical anomalies at the Chingozi ultrabasic intrusion south of Mount Mlanje.

Negotiations were begun between the Government and Lonrho Malawi Ltd. concerning the company's application for a mining lease covering the Kangankunde monazite-strontianite deposit. The deposit was reported to contain 300,000 tons of ore with 5.6% high-europium, low-thorium monazite and 18% strontianite. British Gypsum Ltd. renewed its exclusive prospecting license at the Kapirikamodzi vermiculite deposit and was granted an exclusive prospecting license covering the Kapirikadima kyanite mineralization area. During the year, a 100-ton bulk sample of kyanite was exported for testing by potential customers.

Gemstones (Malawi) Ltd. exported small amounts of agate, aquamarine, garnet, mica, and ruby corundum to gem and mineral dealers in 1976. An emerald deposit was reported in the Mzimba District late in the year.

The UNDP project "Ground Follow-up to Airborne Geophysical Surveys in Four Selected Areas" was concluded, and the restricted areas in the Nsanje, Dzalanyama, Karonga, and Rumpi Districts were reopened for mineral license applications.

The economy of Malawi continued to be strained by the high cost of imported petroleum products. Malawi imported approximately 1 million barrels of refined petroleum products at an estimated cost of $22 million [36] during 1976.

The Government applied for loans and credit from the ADB and other lenders for construction of the Nkula Falls "B" hydroelectric project. The first phase was to have a 36-megawatt output, with further development to 90 megawatts, and was to be adjacent to the existing Nkula Falls "A" project on the middle section of the Shire River.

MALI [37]

The mineral industry of Mali contributed a very small portion of the nation's 1976 GDP of $590 million [38] at current prices, which was up 11.2% over that of 1975.[39] Mineral production consisted of cement, gold, and salt. Most mineral development was in the exploration stage. Deposits re-

[35] Prepared by David E. Morse.
[36] Where necessary, values have been converted from Malawian kwacha (MK) to U.S. dollars at the rate of MK1.095=US$1.00.
[37] Prepared by Janice L. W. Jolly.
[38] Where necessary, values have been converted from Malian francs (MF) to U.S. dollars at the rate of MF490=US$1.00.
[39] U.S. Embassy, Bamako, Mali. State Department Airgram A-17, July 28, 1977, p. 8.

ported by a recent study by the Ministry of Mines included iron (approximately 597 million tons), manganese (10 million tons of 40% to 60% manganese), bauxite (880 million tons of 40% to 50% Al_2O_3), lithium (265,000 tons of 6.5% lithium), rock salt (53 million tons), gypsum (370,000 tons), limestone (22 million tons), asphalt (350 million to 400 million tons), and clay (37 million tons). Phosphates, lead and zinc, cobalt, uranium, diamond, and copper deposits had also been reported; however, most of these deposits are in extremely inaccessible regions.

Manufacturing, including handicrafts and artisans' production, accounted for 11% of the GDP. Virtually all large enterprises were owned by the State, and the remaining few had mixed ownership. In 1976, nine new plants opened, including a small private battery factory. The investment climate was reported as favorable for foreign companies, but manufacturers have been and will probably continue to be required to offer the Government a percentage ownership of 10% to 50%. In general, the basic Government of Mali Code of Investments of 1969, the Mining Code (Ordonnance No. 34/CMLN of September 3, 1970), and the Petroleum Code (Ordonnance No. 30/CMLN of May 23, 1969 (modified April 20, 1970)) are followed. The basic Code of Investments offers various incentives, mostly in the form of tax-free privileges for 5 to 10 years, to companies prepared to invest in nine areas of interest to the Malian Government, including metallurgical industries and energy production.

Total exports were valued at $123 million and total imports at $202 million, resulting in a net trade deficit. The overall balance-of-payments deficit, defined as the change in net foreign assets of the Central Bank, amounted to $33 million in 1976. As in previous years, much of the deficit was financed through the operations account with the French Treasury.

The electrical output of Mali was 76 million kilowatt-hours in 1976, which was insufficient to meet local demand. The hydroelectric powerplant at the Sélingué Dam was expected to enter production by 1980 at a rate of 44 million kilowatt-hours per year.

Mineral development in western Mali was dependent upon progress made in the Senegal River Development Organization (OMVS) programs. The regional infrastructure was to be jointly owned and managed by the three countries involved (Mali, Mauritania, and Senegal). The initial phase was estimated to cost $324.5 million and would include the Manantali Dam and powerplant; the Diama Dam, an antisalt and irrigation dam to be built in Senegal; the ports of Saint Louis and Kayes and development of the waterway; and the electrical infrastructure. Major construction work on the initial phase was expected to be complete by late 1984. OMVS activity over the past 2 years was reviewed at a meeting of the heads of state in July 1976 at Dakar, Senegal. Foreign financial commitments and loans were announced that would provide over 60% of the necessary funds for the initial phase of the major OMVS projects. West Germany pledged $60 million; the ADB, $46 million; Kuwait, $38.3 million; Saudi Arabia, $30 million; France, $18.6 million; Canada, $4.9 million; and Iran, $4 million. The three OMVS countries were to jointly guarantee the loans.

After a preliminary feasibility study of the Manantali Dam and powerplant project yielded a total estimated construction cost of $200 million, the People's Republic of China decided not to participate. The Manantali Dam was a keystone of the OMVS program and was to serve a triple purpose. By regulating an assured river flow of 300 cubic meters per second at Bakal, the dam would permit irrigation of about 500,000 hectares in Mali and year-round navigation from Saint Louis to Kayes, and the associated powerplant would produce an annual 400 million kilowatt-hours of electricity (800 million kilowatt-hours after flooding is discontinued). The dam would be 70 meters high and 1.5 kilometers long. The powerplant would have a 100-megawatt capacity and would help meet future needs of western Malian mining and industry development. The volume of stored water would be 10 billion cubic meters. A contract was signed with the Euro-African Association of Engineering Consultant Firms for engineering and design studies, which were expected to last 30 months from July 1976 to December 1978. Selection of construction firms was to take place during the first half of 1979. Construction was expected to take 5 years. The river port of Kayes will have a dry dock, a

petroleum-handling area, and facilities for transshipping from river to rail.

Approximately $6 million was allotted under the 1974–78 mineral development plan for exploration operations in western Mali. Included were plans for detailed prospecting operations and feasibility studies of the iron ore deposits (500 million tons of reserves) in the Bafing-Makana Basin; the Balé iron ore deposit (130 million tons of probable reserves at 40% to 63.5% iron), located 80 kilometers southwest of Kita; and the Djidian-Kéniéba iron ore deposit (about 12 million tons of reserves at 56% to 68% iron), located near the future Manantali Dam site. The Diamou-Bafoulabé iron ore deposit was reported as poorer in quality (150 million tons of ore with over 40% silica and 30% to 40% iron). Continued exploration and prospecting operations were planned for the bauxite at Baléa and Sitaouma, with reserves of about 400 million tons of 39% to 43% Al_2O_3. Prospecting by BRGM of France would continue for copper and associated metals in the Kayes, Nioro, and Bafoulabé regions. BRGM was reported thus far as having found a copper indication near Kayes that was not economic.[40]

The Japanese Government-financed company Power Reactor and Nuclear Fuel Development Corp. (PNC) held uranium-prospecting concessions at Tessalit and Kidal, where the company was reportedly expected to spend $4 million on exploration. Three types of uranium mineralization were reported in Mali: Granitic, with small veins averaging 0.4% U_3O_8, discovered by the Japanese near Tessalit; shale type in metamorphics (schist or argillite); and sandstone type, like the Niger uranium deposits. The shale uranium deposits occur around Araouane, and the sandstone variety occur to the south near Kidal in the Japanese concession. Seven areas of radioactivity had been located in the Kidal area, and drilling and field examinations had indicated that three of these might be commercially promising. PNC was following up with a prospecting campaign involving 35 technicians that was expected to last through 1978.

Several interesting lead-zinc and cobalt anomalies were reportedly found in an area south of Bamako by BRGM. BRGM was also prospecting near Ansongo and in the Bougouni-Sikasso region and was to do a general minerals study for Mali. The Malian Government mining organization Société Nationale de Recherches et d'Exploitation Minières (SONAREM) was also exploring around Ansongo, Kéniéba, and Sikasso. The Malians were doing geophysical surveys for massive sulfide bodies near Ansongo. Copper and manganese deposits (3.3 million tons of probable reserves at 40% manganese) were reported in the Ansongo-Gao region. Phosphate (20 million to 25 million tons at 27% P_2O_5) was reported in the Tilemsi Valley of the Adrar des Iforas area. Exploration and mapping projects for the Liptako-Gourma area adjoining Upper Volta were expected to involve investments totaling $5 million, most of which was for a geologic map and general prospecting costs. CIDA was funding an airborne geophysical survey in Mali and Upper Volta. The work was being done by Kenting Earth Sciences.

The only mining project, the gold mine at Kalana operated by the U.S.S.R. and SONAREM, had not yet started official production. Under the 1974–78 mineral development plan, three gold-mining projects were slated to be operated by SONAREM with aid from the U.S.S.R. SONAREM's contribution funds would equal approximately one-third of the Soviet aid,[41] which in 1975–77 would total $4.7 million. The first contract was signed in April 1973, followed by a technical survey by the Soviet institute Credmet. During 1975, the following program was decided upon: The first phase, lasting 2 years, would include detailed prospecting with an annual production of 25,000 tons of ore. Construction of inclined wells and cross shafts, the industrial site, and temporary workers' lodgings would be completed. The second stage would include sinking of vertical shafts and construction of permanent workers' lodgings. An annual production of 60,000 tons of ore was expected in the second phase, which would include expansion of the treatment plant and addition of a cyanidation unit. The first stage would cost approximately $5.9 million, and the total project cost was expected to be $16.6 million. Prospecting operations at the Kodiéran gold deposit situated 6 kilometers from Kalana began in 1976. Diamond prospecting

[40] Bureau de Recherches Géologiques et Minières. 1975 Annual Report (Paris). Mali. P. 54.

[41] Bulletin de l'Afrique Noire (Paris). Mining Development. Dec. 17, 1975, pp. 16540–16541.

with Soviet aid was also to resume in the Kéniéba region by 1978.

Feasibility studies for a second cement plant to be constructed near Bamako were to be done by a West German firm. The Soviet-built cement plant near Kayes continued to have technical problems. The energy cost was considered to be excessive for the amount of cement produced.

At the beginning of 1976, West German geologists explored the region between Gao and Ofalik for base metals. Apart from uneconomic manganese mineralization, no anomalies were found that would warrant a followup program.[42]

Texaco was withdrawing from oil prospecting. Murphy Oil Corp. of the United States continued petroleum exploration in its permit area of 16,250 square kilometers north and northeast of Gao. Sun Oil Co. had a permit area adjacent to and east of the Murphy area. Mali imported a total of 481,108 barrels of refined petroleum products from Senegal and the Ivory Coast in the first 6 months of 1976.

MAURITANIA [43]

The mineral sector of Mauritania, consisting mainly of production of iron ore, copper, and gypsum, was the mainstay of the country's economy in 1976. Société Nationale Industrielle et Minière (SNIM), the State industrial holding company in charge of mining operations, planned to invest $500 million [44] in the next 5 years in mineral development. The major projects were exploitation and upgrading of low-grade iron ore deposits, construction of a steelmill, and expansion of copper mining to supply a new copper smelter. Exploration continued in 1976 with promising indications for the further development of base metals, gypsum, and uranium. On October 16, 1976, a new investment code was adopted to encourage foreign investment in Mauritania; among its economic incentives were tax exemptions, guarantees against nationalization, and provisions for profit repatriation.

Output and exports of iron ore, which provided over 70% of Mauritania's export earnings and 20% of its budget, showed a substantial improvement over the 1975 figure. Exports of copper and gypsum, however, both decreased. In general, the mineral industry suffered from elevated costs owing to insufficient infrastructure, scarcities of water and power, and loss of foreign technicians. In addition, oil consumption increased 24% to 165,000 tons. To offset its adverse balance of payments, Mauritania was granted $5.5 million in standby credit by the International Monetary Fund (IMF). Also in 1976, the country received approximately $150 million in aid from the Arab oil-producing countries.

During 1976, iron ore transport from the Zouérate mining district was interrupted by the destruction of a rail link to the port of Nouadhibou. SNIM undertook the construction of a 14-kilometer bypass around Choum Tunnel to reduce the vulnerability of the 650-kilometer railroad. The new rail link was to be completed in 1977 at a cost of $1.5 million.

Construction began in 1976 on extensions to the port of Nouadhibou, scheduled for completion at yearend 1978. The $27 million project was financed by Kuwait, the IBRD, Caisse Centrale de Cooperation Économique (CCCE) of France, and the Mauritanian Government. At the same time, a deepwater port was under construction at Nouakchott, financed by the People's Republic of China. Progress was made in 1976 on construction of the Nouakchott-Néma road, a major project intended to open up the eastern part of the country. The $100 million road was financed by Saudi Arabia, Kuwait, and the United Arab Emirates. The first section, 600 kilometers in length, was to be commissioned in 1977.

Several mineral exploration programs were ongoing in 1976. Geological teams from Romania conducted research on lead-zinc and copper deposits in Adrar, phosphate in the Taoudenni Basin, iron ore in Tiris and Tasiast, and copper in Affolé. Mauritania and the U.S.S.R. signed a protocol during the year for general mineral research and geological prospecting. The Division de la Recherche Géologique of SNIM initiated studies for the preparation of a national geological map. Uranium ex-

[42] Page 32 of work cited in footnote 10.
[43] Prepared by Candice Stevens.
[44] Where necessary, values have been converted from Mauritanian ouguiya (UM) to U.S. dollars at the rate of UM44=US$1.00.

ploration on a 165-000-square-kilometer area in the Tasiast and Dorsale Reguibat regions continued under the direction of CFP in conjunction with PUK, CEA, and Tokyo Uranium Development Co. Phosphate exploration, undertaken by BRGM and the Romanian firm Geomin, was terminated in 1976 owing to negative results.

On April 14, 1976, Morocco and Mauritania signed an agreement formally establishing their sovereignty over Spanish Sahara and providing for economic cooperation in exploitation of the Bu Craa phosphate mines. Spain, which ceded the territory of Spanish Sahara to the two countries in 1975, retained a 35% interest in the phosphate mines, where reserves were estimated at 10 billion tons. Plans called for phosphate production to reach 10 million tons per year by 1980. Mauritania and Morocco also agreed to undertake joint exploration of the mineral resources of Spanish Sahara.

Production of iron ore at Zouérate, situated in northeastern Mauritania near the Spanish Saharan border, increased from 8.7 million tons in 1975 to 9.7 million tons in 1976. The three mines, Tazadit, Rouessa, and F'Derick, were under the direction of Complexe Minier du Nord (COMINOR), a division of SNIM. All output was exported, the primary purchasers consisting of France (23%), the United Kingdom (17%), Japan (15%), Italy (13%), and West Germany (12%). Combined reserves of the three mines, where production was to be phased out by 1985, were 1 billion tons of 65% iron.

The decline in activity at the older mines was to be compensated for by exploitation of lower grade ore reserves in outlying bodies known as the Guelb deposits. Situated within a radius of 50 kilometers of Zouérate, total reserves of the Guelbs were estimated at 2 billion tons of magnetite ore averaging 38% iron. Exploitation was to begin in 1981 at an annual production capacity of 6 million tons. Approximately $300 million was to be invested in the development of the Guelb deposits between 1977 and 1986; financing was to be provided largely by the Saudi Arabian Development Fund and the Kuwaiti Fund for Arab Economic Development.

A ministeelworks was to be constructed in Nouadhibou at a cost of approximately $10 million. Initial capacity of the steelmill, which would produce rods and bars for construction purposes, was to be 12,000 tons per year. Energy requirements were to be provided by a new power station under construction at Nouadhibou.

Copper production at Akjoujt totaled 9,431 tons in 1976; the mine operated at 50% capacity owing to technical difficulties and the loss of foreign technicians. Mauritania nationalized the foreign shareholdings of Société Minière de Mauritanie (SOMIMA) and placed the copper mines under the direction of SNIM in 1975. Copper oxide ore, estimated at 2.3 million tons averaging 2.7% copper, was due to be exhausted by 1980. Exploitation of copper sulfide reserves, estimated at 13.7 million tons averaging 2.3% copper, was to begin at that time. Although copper sulfide reserves were considered less difficult to process than the copper oxide ore, new equipment for extraction and concentration was necessary.

Société Mauritano-Kowetienne des Industries Métallurgiques, a joint venture of Mauritania and Kuwait, was to complete the installation of a copper smelter at Nouakchott toward the end of 1979. The smelter was to process concentrates with a copper content of 25% and produce 30,000 tons of copper and 100,000 tons of sulfuric acid per year.

Production of gypsum at Sebkha de Ndrhamcha, located 65 kilometers north of Nouakchott, declined from 12,700 tons in 1975 to 11,200 tons in 1976. The major part of the output was exported to Senegal for use in the Société Ouest-Africaine des Ciments (SOCOCIM) plant at Rufisque. Mauritania continued to rely on imported cement, which amounted to about 70,000 tons in 1976. SNIM planned the construction of a plaster works near the gypsum deposit and solicited bids for its construction during the year. The $700,000 plant was to have an annual capacity of 11,000 tons for local distribution.

Most of the foreign petroluem companies, including Texaco, Esso, Shell, and Western Enterprises, Inc., relinquished their oil-prospecting concessions in 1975–76 owing to disappointing results. However, a new agreement was concluded in 1976 with a group consisting of Getty, Phillips, Hispanoil, and Agip for petroleum exploration in the Cap Blanc area. The 24,000-square-kilometer tract included both onshore and offshore areas south of Nouadhibou. Hispanoil was to be the operator for the con-

sortium, in which each company had a 25% holding.

L'Unité de Comercialisation des Produits Pétroliers (UCPP) was responsible for the sale and distribution of all petroleum products in Mauritania. Under the supervision of UCPP, construction continued in 1976 on the petroleum refinery at Nouadhibou. The Austrian firm Vöest-Alpine was contracted for construction of the refinery, which was to have an annual production capacity of 1 million tons of petroleum products.

MAURITIUS [45]

The mineral industry of Mauritius contributed less than 1% to the estimated 1976 GNP of $366 million [46] at current prices, up 6.9% over that of 1975. Foreign trade accounted for about 60% of the GNP.

The 1976 mineral production consisted of salt (5,500 tons valued at $269,058), lime (7,300 tons valued at $412,407), and basalt (400,000 tons valued at $1.5 million). The Mauritius Chemical and Fertilizer Industry Ltd. plant was producing 200 tons per day of a new ammonium sulfate compound, in addition to two different formulas of NPK fertilizers (17–8–75 and 17–2–25). The firm produces some 6,000 tons of fertilizer per month.

Without significant natural resources, aside from a fertile soil, Mauritius must import most raw material. The Government encouraged industrialization by a series of tax advantages and other incentives for growth. By December 1976, there were 81 factories in the Export Processing Zone (EPZ), which was started with 9 companies in 1970. Over 28,000 jobs were created in the EPZ since 1970. The Government's objective continued to be full employment, requiring 76,000 new jobs by 1980, including 47,000 in industry. Priority attention was being given to the development of export-oriented industries.

Mauritius offers a favorable investment climate to industries that are export oriented, offer high employment possibilities, and generate foreign exchange earnings. Investments are encouraged by exemption from import and excise duties on raw materials and complete exemption from payment of import duty on capital goods; a corporate income tax holiday for a minimum of 10 years and a maximum of 20 years; loans at preferential rates for the importation of raw materials; electric power at preferential rates; provision of reinforced factory buildings for use by industrialists; and an agreement in principle to exemption from income tax of those profits earned from foreign investments in Mauritius if they are not transferred but are reinvested in Mauritius.

Anticipating further growth in industrialization, the Central Electricity Board (CEB), a public corporation, was expecting to increase the electric power supply 11% per year during the next 5 years. Two new major power stations were being built at Baptistes-Guibies and Quatre-Bornes. Another station was planned for Grand River Southeast. Between 1969 and 1974, consumption increased 10% per year, owing mostly to the increased industrial growth. The European Investment Bank loaned $2.2 million to the CEB for expansion of the thermal power station at Fort Victoria. On December 3, 1976, a 6½-year, $3.4 million loan was finalized between Citibank and the CEB for the acquisition and erection of two 12-megawatt thermal generators at Port Louis. CCCE of France signed an agreement on October 18, 1976, for loaning $4.3 million to be used to construct a 12-megawatt electric powerplant in Port Louis. This was the third loan CCCE had provided to Mauritius. The Arab Bank for Economic Development in Africa granted $10 million for the Guibies reservoir and hydroelectric plant. The loan was to be repaid in 15 years at 4% interest. The new reservoir at Guibies was to have a 32-million-liter capacity and would provide water for Port Louis and the surrounding area. A hydroelectric plant of 8-megawatt capacity would also be built. An $850,000 Canadian grant was to be used to improve the Rodriguez water supply.

Mauritian trade ties remained strong with the United Kingdom, France, and India. Mauritius also worked hard in establishing firmer relations with other African countries and emerged in 1976 with the chair-

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[45] Prepared by Janice L. W. Jolly.

[46] Where necessary, values have been converted from Mauritian rupees (Mau Rs) to U.S. dollars at the rate of Mau Rs6.69=US$1.00.

manship of the OAU. An investment guarantee agreement was concluded with the United States, and OPIC political risk insurance was made available for certain projects.

In early 1976, the Government announced that the Mauritian rupee would be linked to the Special Drawing Rights (SDR) of the IMF and no longer to the pound sterling. This step was to assure the promotion of investment and make it possible to combat inflation in Mauritius.

Under a recent agreement between the Mauritian and British Governments, two mapping projects were to produce new topographical maps of Mauritius. Maps for general planning purposes at a 1:25,000 scale would make up the first project. The second project calls for production of maps at a 1:2,500 scale for certain developed or developing coastal regions. These maps were expected to be useful for civil engineering surveys and town planners and assessors. Aerial photography for these two projects was accomplished in November 1975 by Hunting Surveys and Consultants Ltd. under a British contract.

No changes were reported in the petroleum exploration or concessions status for 1976. At last report, Texaco held all 57,000 square miles of rights. No exploratory work was performed, and there was no drilling activity. A total of 834,597 barrels of refined petroleum products was imported during the first 6 months of 1976 from Iran, Kuwait, Bahrain, the Republic of South Africa, and Madagascar.

NIGER [47]

The mineral industry of Niger, although small compared with agriculture and other industrial sectors, assumed importance in the overall economy in 1976. By yearend, Niger's uranium industry was in a very healthy state. Production of semiprocessed uranium yellow cake from Niger's single open pit mine operated by Société des Mines de l'Air (SOMAIR) steadily increased from 429 tons in 1971 to 1,722 tons in 1976, and was expected to reach 2,000 tons by 1977. Although prices for uranium were negotiated between the Niger Government and CEA, the French atomic energy authority, gross income of the uranium sector was about $83 million.[48]

SOMAIR operated the Arlit mine, 450 miles northeast of Niamey, and was the sole producer of uranium in 1976. SOMAIR is an international consortium comprising the Government of Niger, CEA, Compagnie Française des Minerais d'Uranium (France), Société Minière Péchiney-Mokta (France), Urangesellschaft mbH & Co. K.G. (West Germany), and Agip Nucleare S.p.A. (Italy). Another international consortium, consisting of Niger, France, Japan, and Spain—Compagnie Minière d'Akouta (COMINAK), established in 1976—began to develop the Akouta mine in 1976. An output of 2,000 tons per year of uranium concentrate was expected by the end of 1978. The Akouta mine is located to the southwest of Arlit and belongs to the same mineralized zone as the Arlit concession. The capital investment at the Akouta mine was estimated to be $200 million and was financed by stock sales, medium-term loans from Niger banks, and loans from participating companies. The shareholders in COMINAK were as follows: Compagnie Générale des Matières Nucléaires (COGEMA) of France (34%), Office National des Resources Minières (ONAREM) of Niger (31%), Overseas Uranium Resources Development of Japan (25%), and Empresa Nacional del Uranio (ENUSA) of Spain (10%).

Nine uranium exploration permits had been issued by the Government of Niger by the end of 1976. The Government held equity participation in all exploration permits through its agency ONAREM, but this was not required by law and was apparently negotiable. All uranium companies active in Niger were asked by the Government to help finance the $100 million Tahoua-Arlit highway. This road was to link Arlit, the uranium-rich district, to Tahoua through the Saharan section of the country and serve as a trade route through Agadez. It appeared that financial support for the road was becoming a signature bonus to be paid by companies interested in uranium investment in Niger.

At the end of 1976, the Imourarene uranium concession was organized by a

[47] Prepared by E. Shekarchi.

[48] Where necessary, values have been converted from CFAF to U.S. dollars at the rate of CFAF226=US$1.00.

consortium of COGEMA (35%), Conoco (35%), and ONAREM (30%). Preliminary investigations indicated that the Imourarene concession contained 70,000 tons of uranium; the consortium expected to begin production late in 1981.

Another mineral activity of Niger was the placer mining operation of Société Minière du Niger (SMN) that produced about 128 tons of tin concentrates in 1976. Total earnings from the tin operation were reported at $1.5 million. Tin deposits were located about 50 kilometers northeast of Agadez. The Government of Niger established a mixed enterprise, Société Nigerienne du Charbon (SONICHAR), to develop a 4.5-million-ton coal deposit in the Air Mountains. The principal purpose of the project was to provide steam-generated electric power for the SOMAIR and COMINAK uranium mines with the potential to service two additional mines. Total cost of the SONICHAR coal mine and generating plant was put at $90 million. By the end of 1976, the project had run into several problems resulting from lack of coal-mining expertise, overall planning of the generating plant, and transportation.

In October 1976, a major breakthrough in meeting Niger's growing energy needs occurred when a high-tension line began carrying cheap hydroelectric power to Niamey from the Kainji Dam in Nigeria. Under terms of a 1974 accord, Nigeria will provide Niger with 30 megawatts annually for 20 years.

Petroleum prospecting, which began in Niger following independence, involved Djado's sedimentary basins in the extreme northeast of the country in 1960–65, the Talak Basin to the west of the Air Mountains in 1965–70, the western Niger River Basin in 1970–75, and the Niger section of the Lake Chad Basin from 1970 to the present. During 1976, no fieldwork was undertaken, since most of the data gathered earlier were being reevaluated by foreign firms. Only five wells were drilled as a result of all the exploration, and petroleum was struck at only one well, near Lake Chad. Texaco was reevaluating this find, and no firm decision on the operation was made by yearend.

The phosphate deposits discovered by ONAREM at Tapoa and Tahoua remained in the development stage. The latest estimate given by ONAREM for Tapoa's reserves was 250 million tons of 23% P_2O_5, which required beneficiation before marketing; material from Tahoua could be classified as mineral ore.

REUNION [49]

The economy of Réunion, an island in the Indian Ocean approximately 640 kilometers east of Madagascar, remained largely agricultural in 1976. Mineral exploration has been limited to general geological surveys conducted by BRGM. In 1975–76, BRGM conducted ground water surveys in the Galets plains area and near Saint-Denis, the capital. It also completed electromagnetic surveys of selected regions of Réunion, which was an overseas territory of France.

In 1976, Réunion imported goods valued at approximately $460,000 [50]; 54% came from France. Import traffic increased 47% over the 1975 level owing to increased imports of petroleum products. Exports totaled $85,000 in 1976, with 58% of the goods going to France; sugar accounted for 80% of Réunion's exports. The country's major development projects, financed largely by France, consisted of infrastructure improvements including road construction, electrification, and port expansion at Pointe des Galets.

RWANDA [51]

Rwanda's mineral production increased in both quantity and value during 1976 and earned more than 15% of the country's foreign exchange. Cassiterite (tin ore) was responsible for about 60% of the value of the mineral industry and was Rwanda's second largest source of foreign exchange. The Economic Community of the Countries of the Great Lakes (CEPGL), linking Rwanda and Burundi with Zaire as a common marketing unit, was unable to relieve transport difficulties for the landlocked

[49] Prepared by Candice Stevens.
[50] Where necessary, values have been converted from French francs (F) to U.S. dollars at the rate of F4.9=US$1.00.
[51] Prepared by Miller W. Ellis.

country because of congestion on Zaire's road-barge-rail routes to Atlantic ports. Closure of the Kenyan-Ugandan border in July stranded a number of Rwandan transport vehicles in both countries and halted shipments of exports and delivery of imported motor fuel supplies. The acute shortage of fuel for mining equipment and transport vehicles was alleviated by loans from Burundi and Tanzania, but traffic by way of Tanzania was intermittent because of poor road conditions between the Isaka station on the Tanzania railroad and the Rwandan frontier at Rusumo Falls on the Kagera River. Except for air transport, the most dependable route for Rwanda's trade was by road through Burundi to Bujumbura on Lake Tanganyika, by lake steamer to Kigoma, Tanzania, and by rail across Tanzania to Dar es Salaam on the Indian Ocean.

Société Minière du Rwanda (SOMIRWA), owned 49% by the Rwandan Government, controlled about 90% of Rwanda's mineral industry. Compagnie Géologique et Minière des Ingenieurs et Industriels Belges (Géomines), with a 51% interest in SOMIRWA, was responsible for mining operations. Production of gold and beryl was more than double the 1975 output. Only small increases were recorded for cassiterite and wolframite, which were the second and fourth most valuable of Rwanda's export commodities. Production of columbite-tantalite declined slightly. Most of Rwanda's minerals were marketed by SOMIRWA to Société Générale des Minerais (SGM) in Belgium.

Geochemical and radiometric exploration by the United Nations continued during 1976. Abnormal concentrations of lead-zinc and tungsten were found in soils at several localities, and abnormal radioactivity was recorded near Butare in the southern part of the country. Drilling was started to evaluate tin-bearing alluvium and old tailings in the Nyabarongo Valley. SOMIRWA and Géomines participated in exploration drilling and in studies to improve recovery of Rwanda's minerals. Construction of a tin smelter at Kigali was planned.

Expanded utilization of methane gas from Lake Kivu was studied jointly by Rwanda and Zaire. A local brewery consumed 159,120 cubic meters of methane produced by the pilot extraction plant.

Building materials, including sand and gravel, clay, and brick, were undoubtedly produced and consumed in Rwanda, but reliable data as to the quantity and value were not available.

SAO TOME E PRINCIPE [52]

The two-island Democratic Republic of São Tomé e Principe became the smallest of Africa's independent nations in July 1975. Agriculture continued to be the chief industry and cocoa the main export commodity. Financial assistance, grants, loans, and training facilities were offered by a number of nations during 1976, but Portugal provided small ships and appeared to continue as the nation's chief trading partner despite emigration of most Portuguese nationals following nationalization of plantations and reallocation of land to indigenous families.

Of volcanic origin and with 1 to 7 meters of rainfall annually, the islands had fewer than 80,000 inhabitants, mainly farmers and fishermen, in a total area of 1,000 square kilometers. There was no activity in the offshore oil concessions surrounding the islands, but extensions of exploration permits were reportedly being renegotiated by Ball and Collins (Oil and Gas) Ltd. during 1976. Excavation of stone and clay for local building material was probably the country's only mineral activity.

SENEGAL [53]

The most significant mineral production in the Republic of Senegal in 1976 was phosphate rock and derived fertilizer products. A small amount of construction materials, sand and gravel, limestone, and cement was also produced for local consumption. Notable developments during the year were the implementation of capacity expansion programs by the Senegalese petroleum refinery, the start of aluminum

[52] Prepared by Miller W. Ellis.
[53] Prepared by E. Shekarchi.

phosphate mining, and the inauguration of the Dakar Free Trade Zone (DFTZ) in early 1976. Senegal actively sought foreign investment that matched local priorities. An attractive investment code offered tax and other concessions for foreign investors, and the legislation was supported by Senegal's record of equitable treatment of investors since its independence in 1960.

A number of manufacturing firms in ceramics, semiconductors, petrochemicals, and fertilizers, both foreign and domestic, showed interest in establishing factories in the DFTZ. Some of these manufacturers moved into the early stages of construction in 1976 and expected to start production in early 1978.

The objectives, on a priority basis, of the fifth 5-year plan (1977–81) were full production at the Tobène phosphate mines, construction of a phosphoric acid and phosphate fertilizer plant, expansion of the Pout clinker and cement plant, enlargement of the Thiès foundry, and establishment of a small steel-rolling mill for production of rods and sheets.

The main mining activity was centered upon production of phosphates by two companies, Compagnie Sénégalaise des Phosphates de Taiba (CSPTI) and Société Sénégalaise des Phosphates de Thiès (SSPTH). The performance of both firms, which were 50% Government-owned, was affected by poor world markets for phosphate in 1976, causing production, tonnage, and exports to remain static. Production by CSPTI of 1.6 million tons of calcium phosphate was slightly lower than its 1975 record, and export sales declined to only 1.3 million tons. Production of aluminum phosphate by SSPTH reached 208,000 tons in 1976, of which 147,000 tons was exported. The company's total export was about 1.4 million tons. Recipients of Senegalese phosphates, in order of tonnage, were France, the United Kingdom, Greece, and the Netherlands. Estimated reserves at the CSPTI concession, 240 kilometers north of Dakar, were given at 100 million tons grading 65% P_2O_5, while SSPTH's reserves were given at 50 million tons grading 30% P_2O_5.

The Governments of Senegal and Iran continued to study their proposed $500 million[54] phosphate/oil-refining joint venture initiated in 1975. The partnership company, Société Irane Sénégalaise des Pétroles et des Mines (IRANESCO), was considering construction of a $200 million oil refinery at Kayar, north of Dakar, with some 3 million tons per year of crude oil to be supplied by National Iranian Oil Co. The IRANESCO agreement called for Iran to buy 1.0 million to 1.5 million tons of Senegalese phosphates per year. The investment included $200 million for development of a new phosphate mine, $100 million for expanded deepwater port facilities, and a nitrogen fertilizer plant at Dakar. The inter-Governmental agreement stipulated that Senegal must obtain financing for the infrastructure, while Iran was to finance the refinery and part of the mine development. A World Bank team reviewed the project during 1976, but by yearend no firm commitment had been made.

Iron Ore Mines of Eastern Senegal Co. (MIFERSO), organized in 1975, studied the Falémé iron ore deposits in the eastern Kédougou-Saraya district during 1976. MIFERSO's partners were Fried. Krupp Hüttenwerke AG of West Germany, 24%; BRGM of France, 24%; Kanematsu-Gosho Ltd. of Japan, 24%; and the Senegalese Government, 28%. By the end of 1976, available information indicated that reserves of the Falémé ore body were 400 million tons with a 47% iron content. Also, it was concluded that further feasibility studies should be conducted in 1977 to decide on the economics of mining in a remote region of the country with no infrastructure. The Government of Senegal initiated a feasibility study for development of beach sand deposits along the coast of Senegal during the year. Apparently, these sands contained a high percentage of titanium and zirconium minerals. Also, a marble company was organized to develop marble deposits in extreme southeastern Senegal near Kédougou. In 1976, Senegal imported 80% of its domestic marble consumption from abroad. The new company envisages a marble production large enough not only to satisfy domestic requirements but also to export to neighboring countries.

Nine years ago, about 100 million tons of crude oil was discovered offshore the Senegal coast. However, the crude was so heavy that development of the deposit at the time seemed uneconomic. Recent technological developments in the oil industry and the similarity of this crude to that obtained in Venezuela led the Government

[54] Where necessary, values have been converted from CFAF to U.S. dollars at the rate of CFAF226=US$1.00.

of Senegal to enter into a new agreement with a Venezuelan oil company to reevaluate the economics of Senegalese offshore oil. Offshore oil exploration continued 50 kilometers north of Dakar, where Chevron Oil Co. planned tentatively to drill in early 1978. Reportedly, natural gas in quantities equal to 30,000 tons of fuel was located near Cap des Biches in Senegal's Cap Vert region. The Government of Senegal was planning to pipe this gas to a thermal powerplant in the near future. The oil refinery at M'Baô near Dakar processed about 696,000 tons of petroleum imported from Nigeria, Dubai, Algeria, and elsewhere. The products were used primarily for domestic needs.

The country's sole cement plant, owned and operated by SOCOCIM at Rufisque, operated at full capacity during 1976. However, because of high demand by the construction industry, the Government of Senegal imported cement from other African producers at a rate of 10,000 tons per month. To overcome this shortage, Government geologists located a limestone deposit with ample reserves near Pout, just 30 kilometers east of Dakar. The production from this deposit was earmarked as feed for a second cement plant, which the Government planned to build near the limestone deposit. The capacity and cost of this plant were not available.

Table 6.—Senegal: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, all forms	26	74
Copper metal including alloys, all forms	678	445
Iron and steel metal:		
Scrap	32,587	20,875
Ferroalloys	2	7
Semimanufactures	402	1,738
Lead metal including alloys, all forms	148	165
Zinc metal including alloys, all forms	1	11
NONMETALS		
Cement	92,233	103,526
Clays and clay products (including all refractory brick):		
Crude:		
Bentonite	1,768	87,766
Other	(1)	--
Products, nonrefractory	9	25
Diatomite and other infusorial earth	1	--
Fertilizer materials:		
Crude, phosphatic ---thousand tons--	1,883	1,317
Manufactured:		
Nitrogenous	36	23
Phosphatic	118,095	64,780
Potassic	3	9
Mixed	870	--
Ammonia	5	19
Gypsum and plasters	2	14
Lime	1	23
Pigments, mineral, including processed iron oxides	(1)	250
Salt	110,314	110,168
Sodium and potassium compounds, n.e.s	27	107
Stone, sand and gravel:		
Dimension stone, crude and partly worked	726	1,220
Gravel and crushed rock	4,770	538
Sand, excluding metal bearing	2	2
Sulfur:		
Elemental, all forms	23	65
Sulfuric acid	48	29
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	(1)	--
Coal	5	--
Petroleum refinery products:		
Gasoline ---thousand 42-gallon barrels--	r 192	194
Kerosine ---do---	806	846
Distillate fuel oil ---do---	r 385	593
Residual fuel oil ---do---	456	185
Lubricants ---do---	r 38	50
Other:		
Liquefied petroleum gas ---do---	10	10
Unspecified ---do---	r (1)	(1)
Total ---do---	r 1,887	1,878
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	34	--

r Revised.
1 Less than ½ unit.

Table 7.—Senegal: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Oxide and hydroxide	400	700
Metal including alloys, all forms	567	793
Antimony metal including alloys, all forms	1	--
Copper:		
Matte	1	7
Metal including alloys, all forms	117	103
Gold metal, unworked or partly worked ---troy ounces--	64	48
Iron and steel metal:		
Scrap	339	46
Pig iron, ferroalloys, primary steel forms	26	14
Semimanufactures	53,894	30,346
Lead:		
Oxides	35	24
Metal including alloys, all forms	19	76
Manganese oxides	30	89
Nickel metal including alloys, all forms	8	18
Platinum-group metals including alloys ---troy ounces--	7	--
Silver metal including alloys ---do---	r 80	119
Tin metal including alloys, all forms	20	37
Titanium oxides	88	110
Zinc:		
Oxide	37	21
Metal including alloys, all forms	15	111
Other:		
Oxides, hydroxides, peroxides of metals, n.e.s	105	11
Metals, metalloids	9	4
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, etc	r(1)	(1)
Grinding and polishing wheels and stones	20	26
Asbestos	794	1,132
Barite and witherite	20	20
Boron materials:		
Crude natural borates	56	138
Oxides and acid	3	3
Cement	1,498	3,008
Chalk	1,932	1,665
Clays and clay products (including all refractory brick):		
Crude:		
Bentonite	1,543	3,996
Kaolin	74	55
Other	166	126
Products:		
Refractory (including nonclay bricks)	917	1,033
Nonrefractory	1,992	1,394
Diatomite and other infusorial earth	33	98
Fertilizer materials:		
Crude, phosphatic	--	1
Manufactured:		
Nitrogenous	4,346	16,415
Phosphatic	100	(1)
Potassic	12,709	31,636
Other, including mixed	3	4
Ammonia	10,265	17,813
Graphite, natural	15	1
Gypsum and plasters:		
Gypsum	1,438	--
Plasters	473	608
Mica, all forms	2	1,123
Pigments, mineral:		
Natural, crude	135	60
Iron oxides, processed	89	38
Precious and semiprecious stones, except diamond, manufactured --kilograms--	--	13
Salt	75	91
Sodium and potassium compounds, n.e.s	4,725	4,461
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	60	15
Worked	199	515
Dolomite	--	1
Gravel and crushed rock	51	208
Quartz	--	1
Sand, excluding metal bearing	31	53

See footnotes at end of table.

Table 7.—Senegal: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS—Continued		
Sulfur:		
Elemental:		
Other than colloidal	10	14
Colloidal	26,951	18,572
Sulfuric acid	37	50
Talc, steatite, soapstone, pyrophyllite	193	161
Other:		
Crude	229	50
Oxides and hydroxides of barium, magnesium, strontium	--	(1)
Bromine, iodine, fluorine	144	114
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	370	118
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	--	24
Carbon black	69	12
Coal, all grades, including briquets	66	15
Coke and semicoke	625	739
Peat	1	2
Petroleum:		
Crude ---thousand 42-gallon barrels--	5,066	4,919
Refinery products:		
Gasoline ---do---	48	148
Kerosine ---do---	2	1
Distillate fuel oil ---do---	97	7
Residual fuel oil ---do---	r 38	215
Lubricants ---do---	86	92
Other:		
Liquefied petroleum gas ---do---	4	1
Mineral jelly and wax ---do---	8	6
Bitumen and other residues ---do---	26	(1)
Bituminous mixtures, n.e.s ---do---	r 12	7
Total ---do---	r 321	477
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r 646	886

r Revised.
1 Less than ½ unit.

SEYCHELLES [55]

The Seychelles, a cluster of 92 islands in the Indian Ocean about 1,000 miles east of the African coast, became an independent state on June 29, 1976. The islands, which had a population of 58,000, had been a British colony for 166 years and had been under French rule for 40 years before that. The only minerals produced in the past were coral rock, phosphate rock, and guano. Oil exploration was only recently being considered.

Services relating to tourism accounted for nearly two-thirds of the 1976 national income of the Seychelles. Agricultural and industrial production accounted for only one-fourth of the GNP, estimated at about $25 million for 1976. The Government's recurrent expenditure for 1976 was just under $13.7 million, and the country ended the year with a credit balance of approximately $55,000.

The first 5-year development plan (1977–81) was expected to be announced in detail in 1977. The plan was expected to call for a diversification of the economy in order to reduce dependence upon imported goods. Development of natural resources, construction of electric powerplants, and improvement of the road network were also expected to be major projects. Financing for these plans would require large sums of money. Some loans were already forthcoming from the United Kingdom, France, and the ADB. The British Government promised an interest-free loan over 25 years of about $16 million,[56] to be used in part for the La Gogue Dam, which would alleviate water shortages on Mahé, the principal island. The dam was to be finished in 1979.

The only port was Victoria, financed and built by the United Kingdom and opened for use on March 1, 1975. The port had a

[55] Prepared by Janice L. W. Jolly.
[56] Where necessary, values have been converted from Seychelles rupees (SR) to U.S. dollars at the rate of SR1=US$0.137.

handling capacity of 150,000 to 200,000 tons and a pier 215 meters long. Total traffic was only 92,000 tons in 1975, of which no more than 7,000 tons represented export traffic. Imports for the same period were valued at $13.4 million.[57] Mineral fuels accounted for 20% of all imports.

The Seychelles rupee (SR) was pegged to the pound sterling by a fixed parity (SR1 = 7.5 British pence) and thus experienced the same fluctuations as British currency. There was no foreign exchange control.

The country's investment code was very flexible, the corporation tax was only 35%, and the personal income tax could not exceed 35% of gross income. The Seychelles, located at the crossroads of Middle Eastern petroleum traffic, hoped to attract more foreign capital and become a privileged place to invest and deposit funds.

Upon gaining independence, the Seychelles immediately published petroleum legislation paving the way for exploration. Bids were accepted for 60 offshore blocks during 1976. Negotiations for exploration rights were started by Burmah Oil Co. Ltd. of the United Kingdom, Siebens Oil and Gas Co. Ltd. of Canada, and Oxoco International of the United States. No previous oil prospecting has been done in the Seychelles.

Many of the islands in the Seychelles group contain deposits of guano. In 1976, 5,580 tons of guano,[58] valued at $151,776, was produced for export. Assumption Island, a 2,700-acre coral island in the Aldabra group in the western part of the archipelago, contains extensive deposits of guano that accumulated as a product of bird life on the islands prior to human occupation. The deposits occur on the surface of the land and in pits and hollows, where the material was carried by rain. The pit guano is fairly uniform in composition, carrying a high percentage of phosphorus and only small quantities of iron oxide, alumina, and limestone. The surface guano is more variable, with calcium carbonate frequently in high concentration.

SOMALIA [59]

The mineral industry of the Somali Democratic Republic, confined to production of small amounts of salt, meerschaum, tin, and local building materials, played a minor economic role in 1976. Although the emphasis in the ongoing 5-year development plan (1974–78) was on agricultural development, provisions were made for construction of a cement plant and a petroleum refinery. Of the plan's total expenditure of $620 million,[60] 19% was to be devoted to the industrial sector and 25% to infrastructure requirements. However, the plan lagged in its investment schedule owing to inflationary effects on the economy, a balance-of-trade deficit of $126 million in 1976, and insufficient foreign aid and investment.

Foreign aid remained essential to Somali development, and the 5-year plan was dependent on outside assistance for two-thirds of its financing. Major donors in 1976 were the United Nations, the EDF, the People's Republic of China, and the U.S.S.R. Aid from the Arab oil-producing countries increased to approximately $100 million. The United States resumed a modest aid program to Somalia in mid-1976; U.S. exports to Somalia also increased, from $2 million in 1975 to $9.6 million in 1976.

A major infrastructure project, construction of a 1,000-kilometer north-south highway along the Ethiopian border, was near completion. The strategic road was built with the financial and technical assistance of the People's Republic of China. Somali port facilities were being improved by construction of a deepwater port at the capital, Mogadiscio, financed by the EDF and the IBRD. A major Soviet economic aid project, construction of a $27 million dam in Fanole to provide hydroelectric power for the Lower Juba region, was postponed during the year. Somalia's second diesel powerplant was under construction in Balad by the Italian firm Meccaniche Lombarde.

The UNDP continued its long term mineral exploration program in Somalia. Several mineral occurrences were scheduled for in-depth study. Kaolin in the southern areas of Bur Qalin and Bur Dur and the northern areas of Dubato and Qoljeid was to be surveyed and mapped in 1977. Test drilling was to continue at the sepiolite (meer-

[57] Barclays National Review (London). Seychelles. June 1976, p. 47.
[58] U.S. Embassy, Victoria, Seychelles. State Department Airgram A-004. May 4, 1977, p. 1.
[59] Prepared by Candice Stevens.
[60] Where necessary, values have been converted from Somali shillings (Ss) to U.S. dollars at the rate of Ss6.2327=US$1.00.

schaum) and bentonite deposits in the central El Bur area. Molybdenum and copper mineralization in the northwestern Seinat area (Erigavo District) was to be mapped and delineated.

In December 1976, Somalia concluded an agreement with the U.S.S.R. for mineral exploration in the northwestern area. The $10 million program was to consist of a general geological survey of 3 to 4 years' duration covering 13,500 square kilometers. Prospecting would focus on iron ore and tin deposits in this area.

Wyoming Mineral Corp., a subsidiary of Westinghouse Electric Corp. (United States), was negotiating a joint venture with the Somali Government for exploitation of uranium deposits. Previous exploration by the UNDP indicated that the Wabo uranium deposits in southern Mudugh Province contained approximately 5,000 tons of uranium oxide ore averaging 0.07% U_3O_8. The El Bur region in central Somalia, 250 kilometers west of Mogadiscio, was estimated to contain total reserves of 2 million tons of uranium oxide ore averaging 0.12% U_3O_8. Negotiations in 1976 centered on the formation of a tripartite mining consortium, including an Eastern European country, to exploit the deposits.

Somalia's first cement plant near the northern port of Berbera was to be commissioned in 1977. Financed by North Korea, the $12 million plant was to have an annual capacity of 100,000 tons. Gypsum deposits in the Berbera region were estimated at 7 million tons; limestone and clay materials for the cement plant were also available in the area.

A small amount of salt was produced by solar evaporation at the production facility at Hafun in northeastern Somalia. Development of salt production was to proceed in the coastal areas of Merka, Chisimayu, Zeila, and Berbera.

Construction of Somalia's first petroleum refinery, to be located near Mogadiscio, began in mid-1976. The 10,000-barrel-per-day refinery was to produce petroleum products for both local consumption and export. The Iraqi Fund for Foreign Development financed most of the cost of the refinery, scheduled for completion in 1978. In 1976, Somalia imported approximately 1.4 million barrels of petroleum products, primarily from the U.S.S.R. and Iran.

Unsuccessful petroleum exploration caused a number of groups to relinquish their concessions in 1976. Conoco, as operator for a consortium including Royal Dutch/Shell and Agip relinquished its prospecting rights in March 1976. Earlier in the year, the group had spudded the Garad Mare I well in its 42,000-square-kilometer concession in the Indian Ocean. Burmah Oil Somalia Ltd. relinquished its 20,000-square-kilometer onshore concession in southwestern Somalia, and Deutsche Texaco AG relinquished its permits for both onshore and offshore tracts. The only active prospecting group at yearend was Elf-Exxon, which held an 18,500-square-kilometer area centering on the Hafun Peninsula. The group drilled and abandoned the Guardofui I well at 11,028 feet off the northern coast in 1976, and no other strikes were reported.

SUDAN [61]

Although the mineral industry played a minor role in the economy of Sudan in 1976, the year was marked by intensified exploration for petroleum and other minerals. The country embarked on a concerted effort to develop its diversified but unexploited resource base in an attempt to revitalize its low-growth economy. In 1976, Sudan's production of cement, chromite, gold, gypsum, magnesite, manganese, mica, petroleum refinery products, and salt made a small contribution to the GDP of approximately $3.6 billion.[62] The economy was plagued by an inflation rate of nearly 20%, a budget deficit of $330 million, and a balance-of-trade deficit of $450 million. But promising new developments were evidenced in an accelerated petroleum prospecting effort in south-central Sudan, major Japanese investments in the chrome industry, new contracts for asbestos and uranium exploration, and potentially commercial discoveries of iron ore, copper, gypsum, mica, and base metals.

The new 6-year development plan (1977–82) proposed a total spending level of $6.5

[61] Prepared by Candice Stevens.

[62] Where necessary, values have been converted from Sudanese pounds (£S) to U.S. dollars at the rate of £S1=US$2.50.

billion and an annual average growth rate of 7.5%. The plan relied on foreign financing for 52% of its revenues. The Arab Fund for Economic and Social Development mounted an ambitious plan to expand the Sudanese economy and develop the country as a source of food for the Arab world. The Arab countries planned to invest $5.7 billion in Sudan over the 10-year period 1976–85; equivalent investment in a second phase (1986–2000) would focus on infrastructure modernization. In 1976, Sudan received a total of $296 million in foreign aid from Western nations (52.5%), Arab nations (15.5%), the U.S.S.R. and Eastern Europe (15.5%), the IBRD (11.5%), and the ADB (5%).

Sudan and the United States reestablished diplomatic ties in 1976 after a hiatus of 9 years. The U.S. agency AID put into motion a $10 million to $20 million assistance program, and the Sudanese-American Council for Cooperation was established to aid investors and encourage closer economic ties. In 1976, U.S. exports to Sudan totaled $106 million as the United States moved up to second place among Sudan's nonpetroleum suppliers. Sudan actively sought investment from other countries through the passage of the Development and Promotion of Industrial Investment Act. This legislation emphasized investment incentives such as tax exemptions, favorable tariffs, privileged freight rates, and full remittance of profits and capital for foreign companies under certain conditions.

The potential for Sudanese mineral development was to be increased by national investment plans to overcome problems caused by inadequate infrastructure. The Sudan Railway was to undergo a 6-year modernization program. Construction of the new port of Sawakin, which would raise the capacity of Sudanese ports to 6 million tons per year, was to begin in 1977. The French firm Société des Grands Travaux de Marseille was awarded a $26 million contract for construction of the 280-kilometer Jonglei Canal between Juba and Malakal in southern Sudan. In addition, 1,600 kilometers of new roads were under construction by the People's Republic of China (300 kilometers), West Germany (200 kilometers), Yugoslavia (200 kilometers), Italy (300 kilometers), and the Sudanese Public Works Corporation (600 kilometers), with financing from a variety of sources. The most significant section was the 750-kilometer all-weather road from Port Sudan to Khartoum, to be opened in 1978.

Mineral exploration was active in Sudan in 1976, when a number of new prospecting agreements were concluded. Hunting Geology and Geophysics Ltd. (United Kingdom) was to undertake mineral surveys over 30,000 square kilometers of southern Sudan. The $590,000 program was to follow a reconnaissance survey carried out by the company throughout southern Sudan in 1976 which identified a number of target areas for further exploration. The focus was to be on metallic minerals as well as industrial minerals such as limestone, asbestos, clay, and talc.

In August 1976, Sudan signed a protocol with the U.S.S.R. for the continuation of its exploration program of 75,000 square kilometers on the Red Sea coast. Manganese and iron ore deposits along the coast were to be evaluated in a 2-year period. A French technical team was to commence a 3-year feasibility study of the resources of the Red Sea region in 1977. France would bear all costs of the project which would assess the commercial potential of gold, chrome, iron, and magnesium deposits. The Red Sea coastal area was also the focus of a study by the United Nations Revolving Fund for Natural Resource Exploration. Among the United Nations projects to be continued in the next 2 years were feasibility studies of iron ore and manganese deposits and an evaluation of copper deposits at Hofrat en Nahas.

Saudi Arabia and Sudan engaged in joint exploration for zinc, copper, lead, and silver on the Red Sea bed under the auspices of the Saudi-Sudanese Commission for the Exploitation of Red Sea Resources at a cost of $45 million. In September 1976, Preussag AG (West Germany) was contracted to conduct detailed studies of the Red Sea deposits. The Saudi firm Arabian Geophysical & Surveying Co. (ARGAS) and the French firm Compagnie Générale de Geophysique were collaborating on the development of techniques to exploit and process the metals.

Johns-Manville Corp. (United States) and Gulf International Co. continued exploration for asbestos in the Jibal and Qala en Nahl areas. Licenses were granted in 1976 for prospecting on 10,000 square kilometers in Blue Nile and Kassala Provinces for a 1½- to 3-year period. Initial exploration by the Sudanese outlined 20

million to 60 million tons of reserves. If commercial deposits were indicated, the three parties were to form a joint venture for the mining and marketing of asbestos fiber.

Uranium exploration by Agip in southern Darfur and Bahr el Ghazal Provinces yielded positive results in 1976. Deposits in the vicinity of Hofrat en Nahas were estimated to contain 10 million tons of copper and uranium ore. Agip and the Sudanese Government were negotiating a joint venture to exploit the deposits at yearend. In 1976, Wyoming Mineral received a uranium exploration permit for 290,000 square kilometers in southern and northern Darfur Province. Essex Minerals, a subsidiary of United States Steel Corp., was also engaged in uranium exploration in Sudan. The Sudanese Government invited bids for uranium prospecting in other permit areas.

Chromite production in the Ingessana Hills in southeastern Blue Nile Province was reported at 22,000 tons in 1976. The deposits were mined by the Government-owned Ingessana Hills Mines Corp. and the privately owned Blue Nile Chromium Ltd. The State planned to invest $2.5 million to double the annual output of its operation by 1978.

During the year, the Sudanese Government concluded an agreement with the Japanese firms Mitsubishi Corporation and Japan Metals & Chemicals Co., Ltd., for development of chrome deposits in the Ingessana Hills area. A 1-year, $1 million feasibility study was to be undertaken in early 1977 to determine if the reserves could support a 200,000- to 300,000-ton-per-year mining program. The Japanese were to finance all costs of the feasibility study in return for exclusive exploitation rights. The $50 million contract provided for the potential establishment of a joint venture owned 51% by Sudan and 49% by the Japanese companies. The Japanese would have the right to 49% of the production and first option to the remainder. A further element of the contract was the possible construction of a ferrochrome industry in Sudan, to be determined after receipt of the feasibility study.

Cement production in 1976 fell to a new low of 130,000 tons owing to technical difficulties at Sudan's two cement plants. Ambitious development plans caused imports of cement to increase to 77,000 tons in 1975 and 98,000 tons in 1976. Under joint venture projects involving Sudanese, Kuwaiti, West German, Danish, and British investments, the two existing cement plants were to be enlarged and a third factory constructed. Maspion Cement Corp., situated at Atbara in Northern Province, was to undergo an increase in capacity from 225,000 tons to 500,000 tons per year. Nile Cement Co. at Rabak was to reach a production capacity of 120,000 tons per year by 1977. The third cement plant, which was to produce 500,000 tons per year by 1980, was under construction at Derudeb in Kassala Province.

Approximately 18,000 tons of gypsum was mined for use in cement manufacture and the construction industry. Red Sea Gypsum Mining Co. reported the discovery of a deposit containing 250,000 tons of high-quality gypsum in the Nibr Ayit area in 1976. Feasibility studies were to be conducted on this and other deposits in the coastal area north of Port Sudan.

An experimental project to mine mica was established in the Shereik area of Northern Province in 1974. Initial production totaled 550 tons in 1976, and plans for expansion of the mining operation were discussed.

Two gold-mining pilot projects in Irkawit and Gebeit in the Red Sea Hills were to be put into operation by the Government in 1977. In 1976, approximately 300 troy ounces was obtained from the mines and smaller alluvial deposits in the southern Yei, Nabari, and Thingaita River areas. The possibility of reopening the gold workings in the Serakoit region was under study by the British firm Robertson Research International Ltd.

In July 1976, Sudan acquired a 50% interest in Port Sudan Petroleum Refinery Shell and BP (Sudan) Ltd. Shell and BP loaned the Government 78% of the $2.1 million purchase price. The 26,000-barrel-per-day refinery produced 8.0 million barrels of petroleum products in 1976. Almost all crude oil was imported from Iraq.

A second refinery was under construction at Port Sudan as a joint venture between the Sudanese Government and the Saudi firm Triad Naft Co. Ltd. The 200,000-barrel-per-day refinery was estimated to cost $250 million. The new refinery project also involved laying an 815-kilometer, 8-inch pipeline linking Port Sudan and Khartoum. Owing to technical problems, the pipeline would not be opened until late 1977. The

pipeline was being built by Südrohrbau GmbH & Co. of West Germany and McAlpine Services & Pipelines Ltd. of the United Kingdom. Parsons Brown International of Lebanon was the consulting engineer. Initial capacity of the pipeline was to be 600,000 tons per year, later to be expanded to 850,000 tons per year. The pipeline was designed to supply petroleum products to the interior and thus free fuel-carrying rolling stock on the Port Sudan-to-Khartoum Railway.

All petroleum exploration licenses in Sudan were transformed into production-sharing contracts providing for a Government share of between 70% and 80% of oil production. Chevron Overseas Petroleum Inc., a subsidiary of Standard Oil Co. of California, and Texaco Sudan Inc. were the operators for various partnerships. Chevron-Texaco continued seismic work in its 29,000-square-kilometer area on the Red Sea coast. In 1975, Chevron-Texaco acquired a 75% interest in the 2,500-square-kilometer concession of American Pacific International Inc. The Bashayer IA well was completed in February 1976 at 2,787 meters as a gas discovery; it tested 9.5 million cubic feet per day of gas at a depth of 1,860 meters.

Chevron-Texaco acquired a 75% interest in the Ball and Collins concession, which covered 17 blocks with a total area of 13,600 square kilometers onshore and offshore in the area north and south of Port Sudan. In August 1976, a gas strike was made in this concession 25 kilometers offshore. At yearend, the Sudanese Government and Chevron-Texaco were negotiating the commercial development of the offshore gas discoveries.

Chevron also held exploration licenses for 516,000 square kilometers of area in the south-central part of the country. Seismic surveys were underway in 1976, and the exploration program was to be intensified with the initiation of airborne magnetic surveys, gravimetric surveys, and surface drilling. Sudanese Resources Development Corp., a subsidiary of OEC, had its rights to a 14,500-square-kilometer offshore tract canceled in early 1976.

SWAZILAND [63]

Swaziland's mineral industry contributed approximately 13% to the 1976 GDP of $218 million.[64] Asbestos and iron ore dominated mine production, comprising 94% of the total value of mineral sales. Minerals produced were asbestos ($15.9 million), iron ore ($10.8 million), coal ($1.4 million), granite ($348,000), kaolin ($22,000), barite ($16,000), and tin ($13,000). In the past 5 years, the mineral sector has declined in relative importance in the Swaziland economy, and its once dominant position has been taken over by agriculture and forestry. The contribution of iron ore and asbestos to export value fell from 33% in 1970 to approximately 14% in 1976. Iron ore mining was to cease at the end of 1977, and kaolin and barite operations closed down during 1976. Coal, the country's third most important mineral, was expected to be a primary revenue earner during the 1980's. Exploration in 1976 focused on coal and diamond.

A feasibility study was being conducted on extending the Swaziland Railroad to Richard's Bay in the Republic of South Africa for general imports and exports, especially the export of coal. The country has been dependent on a single rail outlet to Maputo in Mozambique through which 80% of Swaziland's exports passed. The new $40 million rail link would integrate Swaziland with the South African railroad and facilitate the opening of a new coal mine and expansion of the fertilizer factory. The Swaziland Electricity Board announced plans to develop an independent domestic power supply at a cost of about $46 million. The thermal power project was to have a capacity of 1,500 magewatts, based on expanded production from the Mpaka coal district.

Production of iron ore at the Ngwenya mine, situated 25 kilometers northwest of Mbabane, declined from 2.2 million tons in 1975 to 1.9 million tons in 1976. Approximately 1.7 million tons was exported to Japan under a 3-year contract due to expire in March 1978. Mining of iron ore at the Ngwenya open pit operation was scheduled to cease in November 1977 upon depletion

[63] Prepared by Candice Stevens.

[64] Where necessary, values have been converted from Swaziland emalangeni (E) to U.S. dollars at the rate of E1=US$1.15.

of the ore body. Shipments of stockpiled fines were to continue until 1979. The Swaziland Government held a 20% interest in the mine, which was operated by Swaziland Iron Ore Development Co. Ltd., a subsidiary of Anglo American Corp. of South Africa Ltd. The evaluation of Swaziland's low-grade iron ore resources continued during the year as the Government sought partners in a joint venture to exploit and upgrade the low-grade deposits. Total iron ore reserves were estimated at 576 million tons with an average iron content of 34%.

Asbestos production at the Havelock mine, located at Bulembu in the northwest, increased from 37,600 tons in 1975 to approximately 39,300 tons in 1976. The underground mine had a capacity of 2,800 tons of ore per day and 120 tons of asbestos per day. Shareholders in the Havelock mine were the Swaziland Government (40%) and Turner & Newall Ltd. (United Kingdom) (60%). During 1976, Lonrho Ltd. (United Kingdom) relinquished all rights to its asbestos exploration concession situated adjacent to the Havelock mine, owing to a lack of positive findings.

In 1976, production of coal by Swaziland Collieries Ltd. at Mpaka in eastern Swaziland decreased to 126,000 tons from the 1975 level of 127,000 tons. Swaziland entered the European coal market in 1976 with the export of 27,000 tons to the Netherlands. A decrease in local demand for coal was further offset by increased sales to Mozambique and Kenya. The Government attempted both to encourage greater domestic use of coal and to secure long term markets abroad. It was anticipated that the projected thermal power station would consume 15% of proven coal reserves.

Swaziland's coal resources in the low veld have been actively explored for several years by independent concerns holding mineral exploration licenses and by the Government's Geological Survey and Mines Department. It was estimated that Swaziland's coalfield, which extended 150 kilometers in a north-south direction between Bordergate and Pongola, contained 224 million tons of anthracite. Among the companies holding exploration concessions were Shell Coal (Swaziland) Ltd., Johannesburg Consolidated Investment Co. Ltd. (JCI), and Anglo American.

Swaziland Barytes Ltd. produced 369 tons of barite in 1976, compared with 200 tons in 1975. At yearend, the company declared bankruptcy, leading to the closure of the mine, situated in the northwestern Londosi River Valley. The Government commenced negotiations with IMCO Services, a subsidiary of Halliburton Co. (United States), for reopening the mine. Proven reserves were 25,000 tons of barite, with estimated reserves of 300,000 tons within the lease area. The thickness of the barite vein ranges from 3 to 7 feet. A pilot plant with a 2,000-ton-per-month capacity consisting of gravity-separation and flotation facilities, operated in 1976.

Production of kaolin at the Mahlangatsha opencast mine, which was closed in mid-year, decreased from 2,260 tons in 1975 to 989 tons in 1976. The Swaziland Government, which acquired the mine from Kaolin (Swaziland) Pty. Ltd. in 1974, continued its evaluation of a new kaolin body near the old mine. Operations at Mahlangatsha, situated northeast of Sicunusa, were indefinitely suspended pending further prospecting and a general reappraisal of the operation.

Small tin and gold operations were taken over by the Government in 1976. Approximately 2.6 tons of tin concentrate was produced at the eluvial tin mine at Sinceni in 1976. All output was exported to the Republic of South Africa. West Germany provided equipment and personnel to explore the extensions of the cassiterite mineralization in the Kubuta area. An experimental gold-leaching plant at Forbes Reef was established by the Government in 1976. Production of gold for the year was 118 troy ounces.

Approximately 51,500 tons of granite was produced at the Van der Meer quarry and sold for use in the domestic construction industry. During the year, Koor Industries Ltd. of Israel announced plans to establish a ceramics factory in Swaziland at a cost of $2.3 million.

Expansions were planned for Swaziland's single fertilizer plant at Matsapa, constructed by National Process Industries (Pty.) Ltd. of the Republic of South Africa, which was commissioned in 1975. Operated by Swaziland Chemical Industries, the plant manufactured chemical fertilizer from ammonia and phosphoric acid imported from Iran. The $3.8 million expansion was to provide the fertilizer plant with its own bulk-blending and granulation units. The plant's 20,000-ton annual output was

marketed in Swaziland and the Republic of South Africa.

A technical team from the United Kingdom initiated a feasibility study for a petroleum refinery in Swaziland. A $58 million refinery was envisaged with production for both domestic use and export. As part of the study, the crude oil docking facilities at Maputo, Mozambique, were examined. In 1976, Swaziland imported approximately 680,000 barrels of petroleum products.

De Beers Consolidated continued diamond prospecting in its three concession areas totaling 260 square kilometers. Bedded deposits near Ehlane in northern Swaziland were shown to contain stones of extremely small size not considered of commercial value. Similarly, disappointing results were obtained from preliminary sample drilling of kimberlite pipes at Dokolwaya.

TOGO [65]

Mining and export of phosphate rock remained the most important mineral activity of Togo. During 1976, Togo's export earnings from phosphate rock accounted for almost one-half of its total export value. About 2 million tons of phosphate was exported during 1976, and with the current expansion underway, the Government was projecting higher exports in 1977. Phosphate mines were nationalized in 1974 when prices in the world market tripled. With the collapse of this high-priced market in late 1975, Togo's export earnings from this source decreased. Nevertheless, during 1976 the phosphate industry returned to a normal condition and was envisaged to remain strong in 1977.

The phosphate industry was controlled entirely by Compagnie Togolaise des Mines du Bénin (CTMB). Operating mines were located near Hohotoe, about 25 kilometers from the Bight of Bénin, where the phosphate ore occurs in rocks of Eocene age with a thickness of 2 to 5 meters, overlain by 6 to 25 meters of sand and clay. The reserves of crude ore were estimated to exceed 100 million tons. A beneficiation plant near the mine utilized saltwater because of the lack of freshwater in the region.

In 1975, Office Togolaise des Phosphates (OTP), the Government office that sells CTMB's rock, undertook to decrease its dependence on sales to its three traditional markets, France, the Netherlands, and Belgium, by cutting the volume going to these countries and seeking new markets and other customers. As 1975 was a year of reduced demand, the first half of the plan was fulfilled easily, but OTP encountered considerable difficulty in finding new customers that year. Total sales for 1976 were more than 2 million tons, however, and during the first 9 months, OTP diversified its market by sales to Poland (220,000 tons), Yugoslavia (109,000 tons), and Romania (24,000 tons).

By the end of 1976, Uranerzbergbau GmbH & Co., a West German-based uranium firm, had succeeded in organizing a company to carry on further feasibility studies and perhaps development work on uranium deposits in the Lama Kara region of northern Togo. The Togolese Government initially held 10% of the company stock, with the option to increase to 30% in the future, and the remaining 90% was to be shared equally by Uranerzbergbau and Wyoming Mineral of the United States. Since the mineralized zone of uranium in Togo extends beyond the border on the east into Bénin, the company planned to expand its exploration activity to Bénin during 1977. The uranium found in Togo, unlike that of the Canadian deposits, lacks associated elements such as gold and graphite. Total investment reportedly would amount to about $10 million [66] at the first development stage.

On December 1, 1976, the first stone of the Togo-Ghana-Ivory Coast clinker plant known as Ciments de l'Afrique de l'Ouest (CIAO) was laid by the Togolese Government. The construction site, 80 kilometers northeast of Lomé, is next to a limestone deposit. After several feasibility studies, limestone was found suitable as a feed material. The plant will have an initial capacity of 1.2 million tons of clinker per year, with a provision to double the capacity in the future. The clinker will go to four large cement plants in Ghana and the Ivory Coast and to one plant in Togo. CIAO and the accompanying infrastructure, such as the rail link to the port of Lomé,

[65] Prepared by E. Shekarchi.

[66] Where necessary, values have been converted from CFAF to U.S. dollars at the rate of CFAF226=US$1.00.

were to cost about $280 million. Production was expected to begin in the early 1980's.

The third 5-year plan for 1976–80 was introduced during the year. An average annual growth rate of 8% was envisaged for the economy during this period. Priorities assigned in this plan were overcoming water problems with improvements in irrigation and hydroelectric systems, rural development and industrialization, and improvements in mining infrastructure such as the port of Lomé, railroad linkage, and road transportation.

The unsuccessful bid of Union Carbide Corp. to search for petroleum in Togo was replaced by one from OEC, also a U.S. firm, in 1976. OEC was to review the old data accumulated by Union Carbide and start a new seismic survey both onshore and offshore Togo. The company was to concentrate its efforts on the remote northern section of the Volta River Basin onshore and within a 200-mile limit offshore. Apparently, the terms of financing provided for an initial 50–50 sharing of production costs by OEC and its partner, Sodeco Togo. OEC, which will be operator for the exploration program, will hold a 90% interest in the non-Government share of production. Sodeco Togo, a Togolese company, will hold the remaining 10% interest.

Construction of a 20,000-barrel-per-day petroleum refinery at Lomé continued on schedule during the year. The refinery will use 1 million tons of Nigerian and Libyan crude oil per year. Owing to the cash flow problem of Togo, the Libyan Government was apparently allowed to purchase 40% of the shares in the refinery during 1976. The refinery and accompanying infrastructure were built by a British firm and cost about $86 million.

UGANDA [67]

The mineral industry of Uganda was a minor contributor to the country's economy during 1976. Mining activity appeared to continue the downward trend that began in 1970. Information was not available on many sectors of Uganda's economy, but mining probably contributed less than 1% to the GDP, or about $12 million [68] in 1976.

Copper retained its position as the dominant metallic product, despite a continued decline in output. Copper metal exports fell to 5,400 tons, a 31% drop from the 1975 level and approximately one-third of the 1970 level. Production of beryl, bismuth, cassiterite, columbite-tantalite, and wolframite continued on a small scale by private investors. Exports of cassiterite were reported at 20 tons during 1976. Production of apatite for fertilizer manufacture was estimated at 5,000 tons. Cement output declined to 87,600 tons, 11% below the 1975 production and 42% below the 1974 production. The reduced cement output was probably a result of the Government's reduced investment expenditures.

Uganda continued to enjoy a positive trade balance during 1976. Total exports increased 30% in value to $348.3 million; the contribution from mining fell from 4% to 2% of the total value. Imports dropped 17.3% to $165.1 million; petroleum products and metals contributed over 25% of the import cost. Exports of nonmineral products, chiefly coffee, provided the overall positive trade balance.

[67] Prepared by David E. Morse.

[68] Where necessary, values have been converted from Ugandan shillings (U Sh) to U.S. dollars at the rate of U Sh7.95=US$1.00.

Table 8.—Uganda: Exports and reexports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS			
Aluminum metal, scrap		r 51	24
Copper:			
Ore and concentrate		2,670	--
Metal including alloys:			
Scrap		r 51	69
Unwrought		r 9,001	7,762
Iron and steel metal:			
Scrap		19	--
Steel, primary forms		110	--
Semimanufactures:			
Bars, rods, angles, shapes, sections		632	71
Tubes, pipes, fittings		r 41	29
Lead metal, scrap		107	31
Tin ore and concentrate		243	85
Tungsten ore and concentrate		176	229
Zinc metal, scrap		1	13
Other ores and concentrates of base metals, n.e.s		9	96
NONMETALS			
Cement		12,637	120
Clays and clay products, nonrefractory		10	8
Fertilizer materials:			
Crude, phosphatic		--	17
Manufactured:			
Nitrogenous		256	40
Phosphatic		14,035	3,403
Other, including mixed		463	--
Quartz and quartzite		5	--
Salt and brine		565	123
Sulfur, sulfuric acid, oleum		658	603
Other, crude		--	31
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline	thousand 42-gallon barrels	14	12
Kerosine	do	--	(2)
Jet fuel	do	--	1
Distillate fuel oil	do	(2)	(2)
Other:			
Nonlubricating oils, n.e.s	do	(2)	--
Bitumen and other residues	do	(2)	(2)

r Revised.
[1] Includes transfers to Kenya and Tanzania.
[2] Less than ½ unit.

Table 9.—Uganda: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS			
Aluminum metal including alloys:			
Unwrought	value	--	$1,142
Semimanufactures		841	[2] 470
Copper metal including alloys:			
Unwrought	value	$450	--
Semimanufactures		250	[3] 28
Iron and steel metal:			
Scrap		347	--
Ferroalloys		171	--
Steel, primary forms	value, thousands	$34	$1
Semimanufactures:			
Bars, rods, angles, shapes, sections		1,866	1,272
Universals, plates, sheets		9,810	4,167
Hoop and strip		117	98
Rails and accessories		464	768
Wire		1,412	559
Tubes, pipes, fittings		1,831	4,012
Castings and forgings, rough		33	11
Lead metal including alloys:			
Scrap		20	--
Unwrought		34	--
Semimanufactures		6	20
Nickel metal including alloys, semimanufactures	value	$2,922	$436
Platinum-group metals including alloys, all forms, but not rolled	troy ounces	1	([4])
Tin metal including alloys:			
Unwrought	value	$14,988	$1,872
Semimanufactures		39	109
Zinc metal including alloys:			
Unwrought		225	167
Semimanufactures		138	2
Other:			
Base metals including alloys, all forms, n.e.s	value	([5])	--
Pyrophoric alloys	do	$135	$21
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		10	1
Dust and powder of precious and semiprecious stones	value	$32,268	$7,004
Asbestos		197	28
Barite and witherite	value	$1,568	--
Cement		2,040	401
Chalk	value	$7,587	$10,579
Clays and clay products (including all refractory brick):			
Crude		240	75
Products:			
Refractory (including nonclay bricks)		1,308	568
Nonrefractory		168	512
Diatomite and other infusorial earth		40	6
Feldspar and fluorspar		694	485
Fertilizer materials:			
Manufactured:			
Nitrogenous		3,280	170
Phosphatic		12	--
Potassic		([4])	350
Other, including mixed		4,348	3,055
Ammonia		12	61
Graphite, natural		23	--
Gypsum and plasters		3,538	3,186
Lime		488	221
Magnesite		10	--
Mica, worked, including agglomerated splittings	value	$6,406	$1,173
Pigments, mineral, natural, crude	do	$1,645	$23,537
Salt and brine		25,021	17,165
Sodium compounds, n.e.s.:			
Caustic soda		2,298	1,474
Sodium carbonate, soda ash		100	104
Stone, sand and gravel:			
Dimension stone		5	75
Dolomite, chiefly refractory grade		318	267
Gravel and crushed rock, n.e.s		91	1,020
Limestone (except dimension)		75	--
Quartz and quartzite		7	([4])
Sand, excluding metal bearing		76	([4])
Sulfur:			
Elemental		2,591	687
Sulfuric acid, oleum		25	12
Talc, steatite, soapstone, pyrophyllite	value	$6,311	$486
Other, crude	do	$55,449	$15,190

See footnotes at end of table.

Table 9.—Uganda: Imports of mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
MINERAL FUELS AND RELATED MATERIALS			
Coke and semicoke		229	1
Petroleum refinery products:			
Gasoline	thousand 42-gallon barrels	1,048	1,061
Kerosine	do	361	390
Jet fuel	do	358	302
Distillate fuel oil	do	627	628
Residual fuel oil	do	519	393
Lubricants	do	59	68
Other:			
Liquefied petroleum gas	do	30	30
Nonlubricating oils, n.e.s	do	2	2
Mineral jelly and wax	do	3	8
Bitumen and other residues and bituminous mixtures, n.e.s	do	r 32	20
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		7	2

r Revised.
[1] Includes transfers from Kenya and Tanzania.
[2] Excludes quantity valued at $6,475.
[3] Excludes quantity valued at $1,277.
[4] Less than ½ unit.
[5] Revised to none.

UPPER VOLTA [69]

Upper Volta is one of Africa's least industrialized nations. The manufacturing-industrial sector accounts for less than 10% of the GNP, which was estimated at $644 million [70] for 1976 in current prices. Minerals were expected to be extremely important for Upper Volta's economic future. In addition to the manganese in the Tambao region, a marble deposit was under exploitation and there was potential for development of cement, gold, copper, nickel, bauxite, phosphates, stibnite, lead-zinc, and perhaps uranium. The overall investment climate was rated as very good. The Upper Voltans had a liberal investment code which granted tax and customs exemptions (up to 25 years in certain cases) and tariff protection, eased foreign currency restrictions, and guaranteed arbitration. As in many other developing nations, a policy designed to increase Upper Voltan control of vital domestic business and financial activities was being pursued. Upper Voltans were required to own at least 51% of the stock in large enterprises.[71]

Voltanization of the capital of industrial firms was outlined in an ordinance of October 30, 1975, which gave foreign firms 2 years to conform. Set at a minimum of 51% in sectors considered priority (banking, insurance, electricity, water supply, distribution of motor fuels, and shipping) and 35% in other sectors, the Voltanization was distinguished from a State takeover in that it may be achieved through the National Deposit and Investment Fund by either private individuals or legal entities under private law. Once the value of shares had been determined, they were offered by the banks to the private sector. If no private source of capital was available, the Fund for Voltanization of Capital was to buy the remainder of the shares, even though the Government might put them on the market subsequently. Among the petroleum-distributing companies, BP preferred to be bought out completely.[72]

Mining experts of the Autorite de Developpement Integre de la Region du Liptako-Gourma (an area which includes Mali, Niger, Togo, and Upper Volta) met in Ouagadougou on September 16, 1976. Their recommendations included establishing a mining research program, including provisions for making a geologic map; exploration for and evaluation of manganese deposits in the area; exploration and evaluation of northern Malian Precambrian

[69] Prepared by Janice L. W. Jolly.
[70] Where necessary, values have been converted from CFAF to U.S. dollars at the rate of CFAF224=US$1.00.
[71] U.S. Embassy, Ouagadougou. Upper Volta. State Department Airgram A-28, Aug. 8, 1977, 6 pp.
[72] Informations d'Outre-mer (Paris). Voltanization of Firms' Capital in 2 Years. V. 24, No. 274, Oct. 13, 1976, p. 7.

sediments and the vanadium- and titanium-bearing magnetites of Oursi in Upper Volta; and an integrated economic study of cement and phosphate needs and production availability of the region.[73] The four countries agreed that better transportation was required to accelerate development and that a policy supporting this sector would be pursued.

The total construction cost of the Tambao railroad project represented a commitment of $113.9 million and was financed by France ($23.4 million), the EDF ($17.9 million), Japan ($15.2 million), West Germany ($15.1 million), the Kuwaiti Fund for Arab Economic Development ($14.1 million), the ADB ($12.5 million), the Arab Bank for Economic Development in Africa ($11.2 million), and Upper Volta ($4.5 million). The principal financiers—representatives from the Ivory Coast, Italy, the World Bank, the European Investment Bank, and the Abidjan-Niger Railway Administration, and the private partners of Société Minière de Tambao (SOMITAM)—were to hold their third conference for the coordination of financial sources for the Tambao railroad in Brussels on January 21, 1977. At this conference, progress reports on the project were to be submitted by Upper Volta, Canada, the Abidjan-Niger Railway Administration, and SOMITAM. Pledges were expected to be made by the Ivorian Government concerning the implementation of port construction in Abidjan and by the Canadian Government concerning the water supply for the mine site. A final decision on the Tambao manganese mine was to be made by the private partners of SOMITAM when the feasibility report is published in June 1977. All agreements were to be finalized by September 1977, at which time it was hoped that work would begin on all projects.

Established on July 16, 1975, with registered capital of $450,000, SOMITAM had as its shareholders Upper Volta (51%), Tamco Company of Japan (30%), Exploration und Bergbau of West Germany (9%), Union Carbide of the United States (7%), and Société de Tambao Manganese of France (3%). The Upper Voltan share was held by two semipublic agencies (the National Deposit and Investment Fund and the National Development Bank (NDB)) 0.5% each and the Government of Upper Volta 50%. The private shareholders were to buy the mine production according to their holdings; thus Japan would take 61.2%, West Germany 18.4%, the United States 14.3%, and France 6.1%. The Government reserved the right to buy a maximum of 10% per year of the production, or 62,500 tons per year based on the expected eventual production of 625,000 tons per year. The deposit contained approximately 13 million tons of manganese oxide averaging 54.5% manganese and 13 million tons of 48% carbonate ore. Feasibility studies were still in progress at yearend.

The General Office for the Tambao Projects, which since 1974 has had the overall responsibility for bringing the Tambao project to production, was also seeking to establish a cement works at Tin H'Rassan. The Tin H'Rassan deposit contained approximately 56 million tons of limestone. The cement plant project was to be financed by a loan from the People's Republic of China. China was conducting a feasibility study of the plant, to be completed by early 1978. The plant was expected to start operation by early 1981. China was also to finance the Tambao-Tin H'Rassan road.

The marble quarry at Tiara was being exploited by Compagnie Voltaique d'Exploitation Minière (COVEMI). Approximately 50 tons of marble block was extracted and exported to the Ivory Coast in 1974 and 1975. The company anticipated extracting 20,000 to 25,000 tons of material per year. COVEMI received a medium-term loan of $535,700 from the NDB, and development was expected to begin by June 1977.[74]

Études Techniques et Realisations, an engineering subsidiary of France's Charbonnage de France Chimie, and Upper Volta Direccion des Mines et de Géologie (DMG) were undertaking an evaluation of the phosphate rock deposits at Kodjani and Aloub Djouana in eastern Upper Volta. The object of the study was to assess the viability of commercial exploitation. The initial budget for the study was $20 million. Preliminary estimates indicated about 250 million tons with an average of 30% P_2O_5. The Arly deposit was the smallest, with around 4 million tons of 27% to 33% P_2O_5. The deposits around Kodjani and Aloub

[73] Industries et Travaux d'Outre-mer (Paris). Upper Volta. V. 24, No. 274, October 1976, p. 731.

[74] Zoma, E. Upper Volta, The Industrial and Mining Situation. Afrique Industrie Infrastructures (Paris). June 1, 1977, pp. 42–45.

Djouana each were estimated at 100 million tons or more. The oolitic phosphate-bearing rock was friable, with little or no quartz and mostly pellets. Open pit mining was being considered.

Studies were being carried out by Société de Recherche Minière (SOREMI) on reopening the Poura gold mine by 1978. Production had ceased in 1966. Good recovery rates by the cyanide process resulted from preliminary tests. In 1976, the Government's share in SOREMI was increased from 34% to 51% through an increase in capital. The original capital of $2 million was distributed as follows: The Government 34.1%, Mining and Chemical Co. 32.4%, BRGM 22.9%, Consultancy and Development 7.5%, and other 3.1%. The workable reserves for the quartz vein were estimated at 15 tons of gold ore averaging 0.48 troy ounce per ton, and those for the old mine dump were estimated at 0.4 tons of gold ore averaging 0.04 troy ounce per ton. Development investment was expected to include draining of the mine, construction of a treatment plant and other buildings, and purchase of surface equipment.

A joint Government-United Nations exploration team reported a lateritic nickel find 7 kilometers from the railroad south of Ouagadougou. The nickel mineralization covered a 6-square-kilometer area of the Boromo greenstone belt. One drillhole intersected 2.5% nickel over a 14-meter distance. Drilling was continuing.

Copper deposits in the region of Gaoua were being investigated by the UNDP. Deposits estimated at 40 million tons with 0.8% copper and 0.06 troy ounce of gold per ton had been located. Geochemical sampling, geophysical testing, and drilling were in progress. The UNDP project was forecast to last 4 years (1976–79) and require a total investment of $3.4 million.

Other deposits being investigated included lead near Gan, lead-zinc at Garango, bauxite in western Upper Volta, and diamond and gold in the Comoé Basin.

CIDA was funding an airborne geophysical survey in Mali and Upper Volta. Covering 205,000 line-kilometers, the survey was expected to be completed by May 1977, using three Kenting Earth Sciences digital survey system units in three aircraft.[75] A West German geophysical advisory group from Bundesanstalt für Gewissenschaften und Rohstoffe (BGR) carried out geoelectric soundings above the phosphate deposit of Aloub Djouana to find ground water horizons, and suggested suitable well sites. In western Upper Volta, near Banfora, a magnetic survey was carried out by BGR to back up the search for diamond-bearing ultrabasite.

[75] Mining Journal (London). Industry in Action. V. 287, No. 7374, Dec. 17, 1976, p. 481.

The Mineral Industry of the Islands of the Caribbean

By Nicholas G. Theofilos[1]

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BAHAMAS

The Bahamian economy weathered the worldwide recession of the last few years better than most developing countries. This was mainly owing to the ties between the tourist industry of the Bahamas and the U.S. economy. The mineral industry played a minor role in the country's economy. The chief mineral exports included an increasing amount of petroleum products from the country's 500,000-barrel-per-day refinery, steel pipe, salt, and aragonite.

A 60,000-barrel-per-day desulfurization facility was completed by Bahamas Oil Refinery Co. (BORCO) in Freeport. The project included vacuum gas oil desulfurization, hydrogen and sulfur recovery, steam generation, water desalinization, and offsite facilities.

The transshipment terminal of BORCO operated at about 75% capacity. The Burmah Oil Co. Ltd. transshipment terminal, which is jointly owned with Bahamas Development Corp., was having its best year since it opened 2 years ago.

Bahamas Cement Co., a totally owned subsidiary of United States Steel Corp., was expected to cease operations by 1977. The decision to close was owing to underutilization of the plant for the past 2 years during the construction slump in its primary market, Florida.

Morton Salt Co. and Diamond Crystal Salt Co., two of the largest salt producers in the Bahamas, exported about 1.3 million tons of salt to the United States, mostly for chemical use.

[1] Foreign mineral specialist, International Data and Analysis.

Table 1.—Islands of the Caribbean: Production of mineral commodities

Area, commodity, and unit of measure [1]	1974	1975	1976 [p]
ANTIGUA [e] [2]			
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	[r] 510	255	NA
Kerosine—do.	[r] 116	54	
Distillate fuel oil—do.	[r] 448	187	
Residual fuel oil—do.	[r] 1,265	566	
Total—do.	[r] 2,339	1,062	NA
BAHAMAS [2]			
Cement, hydraulic—thousand metric tons	794	381	271
Petroleum refinery products: [e]			
Kerosine—thousand 42-gallon barrels	300	--	--
Jet fuel—do.	11,000	9,647	7,708
Distillate fuel oil—do.	11,200	11,038	8,928
Residual fuel oil—do.	45,500	44,645	36,099
Other—do.	12,000	13,372	10,791
Refinery fuel and losses—do.	2,000	744	707
Total—do.	82,000	79,446	64,233
Salt—thousand metric tons	1,027	1,232	1,353
Stone:			
Aragonite—do.	1,483	1,232	2,069
Limestone for cement—do.	989	521	35
BARBADOS [2]			
Gas, natural:			
Gross [e]—million cubic feet	90	125	158
Marketed—do.	85	120	[e] 152
Petroleum:			
Crude—thousand 42-gallon barrels	48	123	110
Refinery products:			
Gasoline—do.	297	305	311
Kerosine—do.	62	68	71
Distillate fuel oil—do.	382	461	378
Residual fuel oil—do.	245	192	279
Other—do.	24	30	33
Refinery fuel and losses—do.	35	123	126
Total—do.	1,045	1,179	1,198
CUBA [2] [3]			
Cement, hydraulic—thousand metric tons	1,814	2,083	[e] 2,000
Chromite [e]—do.	20	[r] 30	30
Cobalt [e]—metric tons	1,600	1,600	1,600
Copper, mine output, metal content [e]—do.	2,900	3,000	5,000
Fertilizer, manufactured, nitrogenous [4]—thousand metric tons	20	50	82
Iron and steel, crude steel—do.	240	240	250
Nickel: [e]			
Mine output, content of oxide and sulfide—metric tons	33,900	36,600	36,800
Smelter [5]—do.	14,900	18,000	18,000
Petroleum: [e]			
Crude—thousand 42-gallon barrels	930	1,000	1,000
Refinery products:			
Gasoline—do.	[r] 7,910	7,910	NA
Kerosine—do.	[r] 3,530	3,570	
Distillate fuel oil—do.	[r] 6,710	6,750	
Residual fuel oil—do.	[r] 18,000	18,300	
Lubricating oil—do.	840	875	
Other:			
Liquefied petroleum gas—do.	812	870	
Unspecified—do.	[r] 1,810	1,920	
Total—do.	[r] 39,612	40,195	NA
Pyrite, gross weight [e]—thousand metric tons	50	50	50
Sulfur: [e]			
Content of pyrite—do.	20	20	20
Byproduct of petroleum—do.	8	8	8
DOMINICA			
Stone, sand and gravel:			
Gravel, crushed—do.	5	23	NA
Pumice and volcanic ash—do.	18	106	NA
Sand—do.	1	2	NA
DOMINICAN REPUBLIC [2]			
Aluminum, bauxite, dry equivalent, gross weight [6]—do.	1,210	754	517
Cement, hydraulic—do.	605	578	531
Copper, mine output, metal content—metric tons	[e] 450	--	--
Gold—thousand troy ounces	--	195	414
Gypsum [6]—thousand metric tons	[r e] 135	147	127
Lime [6]—metric tons	NA	2,150	1,980

See footnotes at end of table.

Table 1.—Islands of the Caribbean: Production of mineral commodities—Continued

Area, commodity, and unit of measure [1]	1974	1975	1976 [p]
DOMINICAN REPUBLIC—Continued			
Nickel:			
Mine output, metal content ——metric tons	30,500	26,900	24,400
Smelter (nickel content of ferronickel shipments) ——do	NA	2,150	1,980
Petroleum refinery products:			
Gasoline ——thousand 42-gallon barrels	2,372	2,734	2,728
Kerosine and jet fuel ——do	407	396	375
Distillate fuel oil ——do	1,879	2,673	2,523
Residual fuel oil ——do	1,629	2,444	4,368
Other ——do	467	545	1,691
Refinery fuel and losses ——do	374	366	489
Total ——do	7,128	9,158	12,174
Salt [e] ——metric tons	40,000	[r] 40,000	40,000
Silver metal ——thousand troy ounces	--	109	907
Stone, sand and gravel: [6]			
Limestone ——thousand metric tons	NA	148	217
Sand and gravel ——metric tons	NA	80	--
GUADELOUPE			
Abrasives, natural, pumice ——thousand metric tons	NA	200	NA
Cement materials, pozzolana ——do	175	NA	NA
Stone, sand and gravel:			
Stone, crushed or broken ——do	385	411	NA
Limestone ——do	975	702	NA
Sand ——do	255	165	NA
HAITI [2 7]			
Aluminum, bauxite, dry equivalent, gross weight ——do	659	522	660
Cement, hydraulic ——do	142	150	245
Clays ——do	43	NA	64
Stone, sand and gravel:			
Limestone, crushed ——do	172	[8] 191	262
Sand and gravel [e] ——cubic meters	NA	20,000	NA
JAMAICA			
Aluminum:			
Bauxite, dry equivalent of crude ore, gross weight thousand metric tons	15,328	11,571	10,306
Alumina ——do	2,805	2,375	1,621
Cement, hydraulic ——do	405	407	365
Clays for cement ——do	[e] 140	[e] 140	132
Fertilizers, manufactured, mixed ——do	25	22	19
Gypsum ——do	269	240	253
Lime ——do	305	183	[e] 244
Petroleum refinery products:			
Gasoline ——thousand 42-gallon barrels	1,717	1,247	1,189
Kerosine ——do	533	401	482
Jet fuel ——do	763	587	481
Distillate fuel oil ——do	1,770	2,136	1,831
Residual fuel oil ——do	6,354	4,990	3,789
Other:			
Liquefied petroleum gas ——do	311	234	281
Unspecified ——do	189	310	212
Refinery fuel and losses ——do	354	284	243
Total ——do	11,991	10,189	8,508
Sand and gravel:			
Glass sand ——thousand metric tons	27	33	26
Common sand and gravel ——thousand cubic meters	1,500	2,300	[e] 2,660
Stone:			
Limestone ——thousand metric tons	[9] 9,098	2,540	868
Other ——do	NA	7,620	1
MARTINIQUE			
Clays ——thousand cubic meters	23	27	NA
Petroleum refinery products:			
Gasoline ——thousand 42-gallon barrels	1,713	1,920	
Kerosine ——do	160	([10])	
Jet fuel ——do	--	--	NA
Distillate fuel oil ——do	711	635	
Residual fuel oil ——do	1,218	940	
Other, liquefied petroleum gas ——do	175	178	
Total ——do	3,977	3,673	NA
Pumice ——thousand cubic meters	110	130	NA
Salt [e] ——thousand metric tons	[r] 163	[r] 163	163
Stone, sand and gravel:			
Stone, crushed and broken ——thousand cubic meters	292	311	NA
Sand ——do	198	255	NA
MONTSERRAT			
Sand and gravel, natural ——cubic meters	11,895	13,915	NA

See footnotes at end of table.

Table 1.—Islands of the Caribbean: Production of mineral commodities—Continued

Area, commodity, and unit of measure [1]	1974	1975	1976 [p]
NETHERLANDS ANTILLES [2]			
Fertilizer materials:			
Crude, phosphate rock ---- thousand metric tons	107	82	54
Manufactured, nitrogenous (sales) [e 4] ---- do	7	21	6
Petroleum refinery products:			
Gasoline:			
Aviation ---- thousand 42-gallon barrels	2,524	1,643	1,276
Motor ---- do	17,508	10,038	15,120
Jet fuel ---- do	20,586	14,427	16,316
Kerosine ---- do	1,420	794	5,906
Distillate fuel oil ---- do	21,182	23,287	21,635
Residual fuel oil ---- do	171,797	128,553	119,283
Lubricants ---- do	3,743	2,373	4,221
Other ---- do	26,484	27,267	28,948
Refinery fuel and losses ---- do	16,354	12,846	13,264
Total ---- do	281,598	221,228	225,969
Salt [e] ---- thousand metric tons	480	480	480
Sulfur, byproduct of petroleum ---- do	116	87	95
ST. VINCENT			
Salt ---- do	100	50	NA
Sand and gravel ---- do	610	12,700	NA
Stone, crushed andesite ---- do	1,830	5,690	NA
TRINIDAD AND TOBAGO			
Asphalt, natural ---- do	77	73	66
Cement, hydraulic ---- do	242	255	242
Clays:			
Argillite ---- thousand cubic meters	148	198	68
Other ---- do	105	74	[11]
Fertilizer materials, manufactured, nitrogenous ---- thousand metric tons	373	333	338
Gas, natural:			
Gross ---- million cubic feet	[r] 128,294	126,490	137,959
Marketed ---- do	[r] 68,457	62,990	78,559
Natural gas liquids ---- thousand 42-gallon barrels	48	61	53
Petroleum:			
Crude ---- do	68,131	78,613	77,673
Refinery products:			
Gasoline:			
Aviation ---- do	421	189	319
Other ---- do	18,651	13,958	10,187
Jet fuel ---- do	8,407	3,870	4,281
Kerosine ---- do	6,065	3,953	6,864
Distillate fuel oil ---- do	14,885	10,827	12,161
Residual fuel oil ---- do	74,485	48,377	67,797
Lubricants ---- do	1,207	517	824
Other:			
Liquefied petroleum gas ---- do	400	332	404
Asphalt ---- do	76	151	130
Unspecified ---- do	2,512	684	11,331
Refinery fuel and losses ---- do	3,711	2,802	3,297
Total ---- do	130,820	85,660	117,595
Sand and gravel:			
Pitch sand ---- thousand cubic meters	37	33	207
Other sand and gravel ---- do	[r] 293	346	360
Stone:			
Diorite ---- do	1	[11]	1
Limestone ---- thousand metric tons	391	425	395
Porcelanite ---- thousand cubic meters	13	13	27
Sulfur, byproduct of petroleum [12] ---- thousand metric tons	[r] 30	49	55

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the countries listed individually in this table, Bermuda, Grenada, and St. Lucia presumably produced crude construction materials (clays, sand and gravel, and stone), but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2] In addition to the commodities listed, mineral output may also include other crude construction materials (clays, sand and gravel, and lime), but data on such production are not collected and available information is inadequate to make reliable estimates of output levels.

[3] In addition to the commodities listed, gypsum, iron ore, manganese ore, pyrite, and salt, all produced in significant quantities prior to the termination of publication of official statistics, presumably were produced during the period covered by this table, but available information is inadequate to make reliable estimates of output levels.

[4] Data are for years ending June 30 of that stated.

[5] Includes nickel content of nickel oxide and nickel fonte in addition to metallic nickel and ferronickel.

[6] Export figures; all production is presumed to be exported.

[7] Presumably salt is also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[8] Consumption figure.

[9] Figure reported in thousand cubic meters.

[10] Included in gasoline.

[11] Less than ½ unit.

[12] In addition, limited quantities of byproduct sulfur from natural gas may be produced.

Table 2.—Bahamas: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS			
Aluminum metal including alloys, all forms		(1)	2
Copper metal including alloys, all forms		1	31
Iron and steel metal:			
Primary forms		--	3
Semimanufactures		801	720
Lead metal including alloys, all forms		3	(1)
Nickel metal including alloys, all forms		--	2
Platinum-group metals including alloys, all forms	troy ounces	--	14,583
Other:			
Ores and concentrates of nonferrous metals		--	377
Metals including alloys, all forms		4,273	1,053
NONMETALS			
Cement	thousand tons	590	189
Clay products, refractory	value	--	$84,797
Fertilizers, manufactured		2	--
Salt	thousand tons	975	1,109
Stone, sand and gravel:			
Gravel and crushed stone		--	2
Sand		23	1
Other	value	--	$3
MINERAL FUELS AND RELATED MATERIALS			
Coke briquets		--	51
Petroleum: [2]			
Crude and partly refined	thousand 42-gallon barrels	27,058	--
Refinery products:			
Gasoline:			
Motor	do	(3)	--
Aviation	do	106	--
Kerosine	do	r 164	85
Jet fuel	do	4,566	5,987
Distillate fuel oil	do	r 7,497	6,285
Residual fuel oil	do	r 49,604	45,575
Lubricants	do	(3)	--
Other	do	11,784	12,266
Total	do	73,721	70,198

r Revised.
1 Less than ½ unit.
2 U.S. Bureau of Mines, Division of Petroleum and Natural Gas. International Petroleum Annual. 1974 and 1975.
3 Revised to none.

Table 3.—Bahamas: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS			
Aluminum metal including alloys:			
Unwrought		22	7
Semimanufactures		257	130
Copper metal including alloys, all forms		129	38
Iron and steel:			
Ore and concentrate		11,431	142
Metal:			
Scrap		2,586	72
Pig iron		--	113
Steel, primary forms		(1)	154
Semimanufactures:			
Bars, rods, angles, shapes, sections		6,324	2,466
Universals, plates, sheets		1,125	1,697
Hoop and strip		13	18
Rails and accessories		4	25
Wire		66	45
Tubes, pipes, fittings		13,851	1,820
Castings and forgings, rough		788	101
Lead metal including alloys, all forms		5	6
Nickel metal including alloys, all forms		(1)	(1)
Platinum-group metals and silver:			
Ores and concentrates		--	2
Metals	troy ounces	3,952	4,565
Tin metal including alloys, all forms		2,028	603
Uranium and thorium ores		2	--
Zinc metal including alloys, all forms		(1)	7
Other nonferrous base metals including alloys, all forms		3	17
NONMETALS			
Abrasives, natural, including industrial diamond	value	$70	$1,161
Cement		87,354	2,153
Clays and clay products (including all refractory brick)		215	185
Fertilizer materials:			
Crude		990	1,450
Manufactured		3,270	2,157
Lime		330	221
Salt		33,162	[2] 28,208
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	thousand tons	112	6
Worked	value	$37,174	$65,718
Gravel and crushed rock		35,880	--
Limestone		1	--
Sand	thousand tons	226	57
Sulfur		--	1
Other, crude		1,863	(3)
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		537	72
Coal		4,119	211
Coke and briquets		263	428
Petroleum: [4]			
Crude and partly refined	thousand 42-gallon barrels	r 110,126	79,900
Refinery products:			
Gasoline:			
Motor	do	532	612
Aviation	do	115	45
Kerosine, including white spirit	do	317	186
Jet fuel	do	43	--
Distillate fuel oil	do	r 808	1,088
Residual fuel oil	do	r 7,443	5,526
Lubricants	do	39	32
Other	do	1	7
Total	do	9,298	7,496
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	value	$38,493	$40,717

r Revised.
[1] Less than ½ unit.
[2] Partial figure; excludes quantity valued at $6,489.
[3] Value only reported at $18,298.
[4] U.S. Bureau of Mines, Division of Petroleum and Natural Gas. International Petroleum Annual. 1974 and 1975.

BARBADOS

The economy of Barbados had a real growth of 6% during 1976. The mineral industry played a minor role, with only small amounts of crude oil, quarry products, and other construction materials produced mostly to meet domestic demand.

General Crude Oil Co. of Houston, Tex., the only operator in Barbados, was continuing negotiations with the Government for exclusive offshore rights. No wells were drilled during 1976, but average daily output from the Woodburne Field increased to 400 barrels from 338 barrels in 1975. General Crude also produced 350,000 cubic feet per day of natural gas, which it sold to a local company.

Table 4.—Barbados: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Alumina	1	1
Metal including alloys:		
Scrap	13	--
Unwrought and semimanufactures	14	2
Copper:		
Ore and concentrate	7	8
Metal including alloys:		
Scrap	89	106
Unwrought and semimanufactures	7	(1)
Iron and steel:		
Ore and concentrate	1	--
Metal:		
Scrap	3,558	806
Pig iron, ferroalloys, similar materials	610	--
Semimanufactures	459	103
Lead:		
Ore and concentrate	11	--
Metal including alloys:		
Scrap	211	99
Unwrought and semimanufactures	1	19
Platinum-group metals, other ores	2,035	62
Tin waste and scrap	3	--
Zinc metal including alloys, unwrought and semimanufactures	(1)	32
Other:		
Ores and concentrates of base metals, n.e.s	5	5
Nonferrous metal scrap, n.e.s	15	--
NONMETALS		
Barite and witherite	--	8
Cement	7	2
Clays and clay products (including all refractory brick):		
Crude	107	205
Products:		
Refractory (including nonclay bricks)	92	1
Nonrefractory [2]	211	135
Diatomite and other infusorial earth	2	1
Fertilizer materials:		
Manufactured	(1)	2
Ammonia	(1)	4
Gypsum and plasters	1	46
Lime	30	--
Salt	29	(1)
Sodium and potassium compounds, n.e.s	5	(1)
Stone, sand and gravel:		
Dimension stone:		
Crude	3	--
Worked	22	1
Gravel and crushed stone	457	4
Sand, excluding metal bearing	61	2
Sulfuric acid	1	1
Other, crude	(1)	(1)

See footnotes at end of table.

Table 4.—Barbados: Exports and reexports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		6	--
Coal, all grades, excluding briquets		3	3
Hydrogen, helium, rare gases		1	(1)
Petroleum:			
Crude	thousand 42-gallon barrels	--	22
Refinery products:			
Gasoline	do	11	4
Kerosine	do	44	(1)
Jet fuel	do	537	193
Distillate fuel oil	do	653	378
Residual fuel oil	do	834	438
Lubricants	do	2	2
Other	do	1	3
Total	do	2,082	1,018

[1] Less than ½ unit.
[2] Partial figures; exclude quantities valued at $12,477 in 1974 and $9,501 in 1975.

Table 5.—Barbados: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS			
Aluminum:			
Oxide and hydroxide		(1)	1
Metal including alloys, unwrought and semimanufactures		591	124
Copper metal including alloys, unwrought and semimanufactures		29	35
Iron and steel:			
Ore and concentrate		--	1
Metal:			
Scrap		64	139
Pig iron, ferroalloys, similar materials		113	[2] 54
Steel, primary forms		4	46
Semimanufactures [3]		18,887	6,415
Lead metal including alloys:			
Scrap		(1)	10
Unwrought and semimanufactures		216	88
Nickel metal including alloys, unwrought and semimanufactures		2	2
Platinum-group metals:			
Other ores		137	7
Metals including alloys	troy ounces	--	64
Silver metal including alloys	do	8,410	--
Tin metal including alloys, unwrought and semimanufactures		811	26
Zinc metal including alloys, unwrought and semimanufactures		34	27
Other:			
Nonferrous metal scrap, n.e.s		(1)	--
Oxides, hydroxides, peroxides of metals, n.e.s		95	72
Base metals including alloys, all forms, n.e.s		3	12
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc		3	1
Grinding and polishing wheels and stones		3	3
Asbestos		11	5
Barite and witherite		--	357
Cement		42,882	37,676
Chalk		30	32
Clays and clay products (including all refractory brick):			
Crude		143	126
Products:			
Refractory (including nonclay bricks)		280	143
Nonrefractory [4]		76	304
Diamond, gem, not set or strung	carats	--	3,181
Diatomite and other infusorial earth		39	44
Fertilizer materials:			
Manufactured:			
Nitrogenous		3,726	5,652
Phosphatic		--	15
Potassic		711	356
Other, including mixed		5,860	5,119
Ammonia		17	21

See footnotes at end of table.

Table 5.—Barbados: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS—Continued		
Graphite, natural	1	(1)
Gypsum and plasters	14	31
Lime	990	815
Magnesite	--	1
Mica, all forms	10	12
Precious and semiprecious stones, except diamond, natural ----carats--	--	1,100
Salt	1,827	1,924
Sodium and potassium compounds: Caustic soda	94	107
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	22	77
Worked	28	27
Gravel and crushed rock	181	92
Quartz and quartzite	--	1,930
Sand, excluding metal bearing	40	19
Sulfur:		
Sulfur dioxide	(1)	(1)
Sulfuric acid, including oleum	131	112
Talc, steatite, soapstone, pyrophyllite	17	32
Other:		
Crude	8	9
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	490	849
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	14	1
Coal, all grades, including briquets	104	73
Coke and semicoke	20	23
Hydrogen, helium, rare gases	5	1
Peat, including peat briquets and litter	13	15
Petroleum:		
Crude and partly refined ----------thousand 42-gallon barrels--	853	875
Refinery products:		
Gasoline ----------do----	176	208
Kerosine ----------do----	71	(1)
Jet fuel ----------do----	591	625
Distillate fuel oil ----------do----	255	404
Residual fuel oil ----------do----	335	465
Lubricants ----------do----	14	16
Other:		
Liquefied petroleum gas ----------do----	87	99
Other ----------do----	6	2
Total ----------do----	1,535	1,819
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	5	2

[1] Less than ½ unit.
[2] Partial figure; excludes quantity valued at $3,701.
[3] Partial figures; exclude quantities valued at $1,031 in 1974 and $538 in 1975.
[4] Partial figures; exclude quantities valued at $179,908 in 1974 and $189,347 in 1975.

BERMUDA

The principal mining activity in Bermuda was the production of small quantities of coral sand, dimension limestone, and crushed limestone. All of this was used to meet domestic demand.

Petroleum consumption was very low owing to the restricted number of motor vehicles permitted to operate on the islands.

Table 6.—Bermuda: Foreign trade in selected mineral commodities

(Metric tons unless otherwise specified)

Commodity		1974	1975
EXPORTS AND REEXPORTS			
Petroleum refinery products (all bunker loadings):			
Gasoline:			
Aviation	thousand 42-gallon barrels	(1)	
Motor	do	19	
Jet fuel	do	1,003	
Kerosine	do	(1)	NA
Distillate fuel oil	do	124	
Residual fuel oil	do	40	
Asphalt and bitumen	do	(1)	
Total	do	1,186	NA
Scrap metal, including waste and sweepings of precious metals	value, thousands	$142	NA
IMPORTS			
METALS			
Aluminum metal including alloys, all forms		1,011	39
Copper metal including alloys, all forms		518	107
Iron and steel metal:			
Pig iron, sponge iron, ferroalloys	thousand tons	1,279	49
Steel, primary forms	do	16	38
Lead metal including alloys, all forms		4	(1)
Nickel metal including alloys, all forms		16	2
Platinum-group and silver metals including alloys:			
Platinum-group	troy ounces	1,044	2
Silver	do	35,949	62,652
Tin metal including alloys, all forms		2	1
Zinc metal including alloys, all forms		1	1
Other, nonferrous		(1)	(1)
NONMETALS			
Cement		9,154	10,173
Clays and clay products:			
Clays and other refractory materials		53	45
Clay bricks		1,051	554
Diamond, not set or strung	value	$58,241	$3,947
Fertilizer materials:			
Crude		11	39
Manufactured:			
Nitrogenous		1	1
Phosphatic		(1)	--
Potassic		1	--
Mixed		746	999
Gypsum and plasters		571	572
Lime		310	240
Precious and semiprecious stones, except diamond:			
Natural	value	$17,840	$5,295
Manufactured	do	$119	$708
Salt		177	173
Stone, sand and gravel:			
Dimension stone		168	162
Gravel and crushed stone		29,511	23,777
Sand		92,902	17,633
MINERAL FUELS AND RELATED MATERIALS			
Coal and coke, including briquets		83	2,066
Petroleum refinery products: [2]			
Gasoline:			
Aviation	thousand 42-gallon barrels	165	176
Motor	do	222	150
Kerosine	do	1	1
Jet fuel	do	214	252
Distillate fuel oil	do	790	2,601
Residual fuel oil	do	572	697
Lubricants	do	28	110
Other	do	22	10
Total	do	2,014	3,997

NA Not available.
[1] Less than ½ unit.
[2] U.S. Bureau of Mines, Division of Petroleum and Natural Gas. International Petroleum Annual. 1974 and 1975.

CUBA

The mineral industry of Cuba during 1976 was essentially based on the very large nickeliferous laterite deposits in the north of Oriente Province in the eastern part of the country. Other important metallic products included cobalt as a byproduct of the nickel industry and chromium. A variety of nonmetallic minerals were mined, including about 1.7 million tons of gypsum for use by the cement industry. Almost all of the country's energy requirements were met by imported petroleum. To alleviate the energy problem, the Council for Mutual Economic Assistance (CMEA) [2] announced plans to assist in building a nuclear powerplant in Cuba.

Nickel mining was based on operations at Nicaro and Moa, where expansion was planned from the combined current capacity of 36,000 tons per year to about 47,000 tons per year by 1980, and eventually to 150,000 tons per year. The first stage of expansion was being largely financed by the U.S.S.R., and the remainder of the program was expected to be financed by funds earned by the nickel industry, whose output is almost all exported. The second stage was scheduled to include a new 30,000-ton-per-year nickel-cobalt oxide plant at Punta Gorda, about 2 miles east of Moa, where reserves were believed to be sufficient to support an operation for more than 50 years. The laterites there have a lower alumina content than those of the Nicaro area (6% to 7% as compared with 10%), and a higher recovery (80%) was anticipated since the plant would be operated with modern equipment.

About 70% of the oxide and sinter produced at Nicaro was exported to CMEA countries. It is claimed to be superior to comparable products from Canada and elsewhere, in that copper content is lower. It is also claimed to have advantages over other ferronickels in terms of its content of chromium, phosphorus, sulfur, and cobalt.

The Government's efforts to find additional petroleum reserves resulted in the discovery of two fields along the northern coast east of Havana, bringing the total number of oilfields in Cuba to 10. But the addition to the country's reserves was modest, because like the older fields dating back to 1881, the new fields were serpentine-plug fields with initially encouraging flows and little long-term potential. Crude oil output thus remained at about 3,000 barrels per day. Commercial gas production, which began in 1971 and reached nearly 2 million cubic feet per day in 1974, began to fall.

Cuba's current 5-year plan called for expansion of existing refineries and the start of construction of a new one. Refinery output was about 120,000 barrels per day, compared with 72,000 barrels per day in 1958, the year before the advent of the Castro regime. The refining facilities included what were formerly Exxon Corp.'s 36,500-barrel-per-day Belot plant and Royal Dutch/Shell's Havana refinery. Since the Government takeover, both plants have been included in Havana's Nico Lopez refinery.

El Cobre's Mina Grande operation achieved a milestone in 1975, mining over 1 million tons of copper ore. A sizable vein of copper between Santiago de Cuba and Camagüey was reported to have been discovered. Development was expected to begin in 1977.

A 100,000-ton-per-year stainless steel plant was planned under the terms of a mutual cooperation agreement with Canada. It was expected to come into production in the mid-1980's and would consume 4,000 to 5,000 tons per year of nickel oxide. During 1976, Cuba imported all of its iron ore requirements.

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[2] Includes the following countries: Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, and the U.S.S.R.

Table 7.—Cuba: Apparent exports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Chromite, gross weight	8,335	25,021	Poland 10,340; Spain 8,575; Austria 6,106.
Copper ore and concentrate, gross weight	2,500	11,350	Japan 6,500; West Germany 4,850.
Nickel:			
Matte and speiss, gross weight	2,562	1,321	Italy 496; Netherlands 384; Austria 381.
Metal including alloys, unwrought	5,503	2,269	Spain 1,459; Belgium-Luxembourg 490; Czechoslovakia 296.
Platinum-group metals ——value, thousands	$141	$67	All to United Kingdom.
Silver ——do	$178	$534	All to France.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline ——thousand 42-gallon barrels	435	347	U.S.S.R. 177; Italy 168.
Other ——do	171	70	All to West Germany.

[1] Compiled from import statistics of trading partner countries.

Table 8.—Cuba: Selected mineral imports from the U.S.S.R.[1]

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, all forms	6,792	7,719
Copper metal including alloys, all forms	5,745	5,202
Iron and steel metal:		
Scrap	59,426	55,355
Pig iron	r 100,248	91,300
Ferroalloys	r 3,252	3,208
Steel semimanufactures	r 243,592	262,937
Lead metal including alloys, all forms	1,202	1,170
Zinc metal including alloys, all forms	500	500
Other metals including alloys, all forms	11,537	11,729
NONMETALS		
Abrasives, hard alloys	1	1
Asbestos	13,976	8,792
Cement, hydraulic	74,000	81,000
Fertilizer materials:		
Nitrogenous:		
Urea	58,757	39,858
Other, manufactured	r 256,398	246,404
Phosphatic	r 151,563	131,910
Potassic	126,700	121,485
Ammonia	13,406	13,211
Refractory materials	25,178	23,304
Sodium compounds, n.e.s.:		
Caustic soda	28,728	30,240
Soda ash	10,167	10,293
Sulfur	146,804	125,520
MINERAL FUELS AND RELATED MATERIALS		
Carbon black	4,079	3,781
Coal:		
Anthracite ——thousand tons	50	44
Bituminous ——do	26	19
Coke ——do	51	32
Petroleum, crude, and refinery products ——do	7,643	8,060

r Revised.

[1] Soviet exports to Cuba, reported in Vneshnyaya Torgovlya S.S.S.R. za 1975 god (Foreign trade of the U.S.S.R. for 1975), Moscow. 1976.

DOMINICAN REPUBLIC

In 1976, there were no major changes in the mineral industry of the Dominican Republic. The Government continued its policy of gaining more favorable terms for the country in concessionary contracts signed with foreign firms for exploration and exploitation of minerals. The only significant mining concerns were those operated for export by Alcoa Exploration Co., Falconbridge Dominicana C. por A., and Rosario Dominicana S.A.

Alcoa's wholly owned mine at Cabo Rojo shipped 517,000 tons of bauxite to its processing facilities at Point Comfort, Tex. The company's contract with the Dominican Government expired December 31, 1976. Pending a new agreement, however, Alcoa continued to operate under the terms of the previous contract.

Falconbridge Dominicana, owned by Falconbridge Nickel Mines Ltd. of Canada (65.7%), Armco Steel Corp. (17.5%), the Dominican State Enterprise Company (CORDE) (9.5%), and minority stockholders (7.3%), was praised by the President of the Dominican Republic for its contribution to the country. In 1976, 56 million pounds of nickel was shipped, compared with 52 million pounds in the previous year. Production, however, fell short of the plant's 68-million-pound annual capacity, and one of the three electric furnaces used in the production of ferronickel remained shut down throughout 1976 owing to reduction in demand. Although the company had exploration rights to 38,000 hectares in addition to the 10,000 hectares currently mined, it planned to divest itself of some of that land in 1977. This would be in line with a policy of gradually shrinking the territory to which Falconbridge Dominicana maintains exploration rights under the 1969 pact.

Rosario Dominicana had its first full year of operation at the Pueblo Viejo gold-silver mine. Producing 414,000 troy ounces of gold and 907,000 troy ounces of silver in 1976, the Pueblo Viejo mine merited the superlatives describing it as the largest open pit gold mine and the fifth largest gold mine in the world. Operations were complicated by numerous modifications being made to the plant to improve efficiency and increase precious metal recovery. Negotiations in regard to the adjacent Los Cacaos concession and additional participation by the Government in Rosario Dominicana lasted the entire year. An agreement was achieved on December 15, 1976, by which Rosario Resources Corp. and Simplot Industries Inc. each sold 15,600 shares of the capital stock of Rosario Dominicana to the Central Bank of the Dominican Republic at book value. This represented a reduction in Rosario Resources' ownership from 40% to 27%. Simplot Industries also ended up with a 27% share, and the remaining 46% was controlled by the Government. Under the terms of the agreement, Rosario Resources, discoverer of the mine and prime mover in its development, was confirmed to have operating responsibility for the mine. Another important provision of the agreement cancelled the tentative Los Cacaos accord, owing to the low grade of the ore body and the soaring costs of a proposed mill expansion at Pueblo Viejo. Reserves of oxide ore at yearend 1976 were 23.5 million tons averaging 0.129 troy ounce of gold and 0.767 troy ounce of silver per ton. The underlying sulfide geologic reserves remained unchanged at 21.1 million tons grading 0.115 troy ounce of gold and 0.839 troy ounce of silver per ton, 1.40% zinc, and 0.14% copper. There is as yet no proven method of profitably processing these sulfides at present metal prices. A research program for metal recovery from the sulfides was continued throughout the year at the Pueblo Viejo laboratory and five metallurgical laboratories in the United States and Canada. The second stage of the tailings dam was under construction to provide sufficient additional capacity to safely store cyanide tailings from the processing of oxide ore.

Negotiations between the Dominican Government and five oil companies for exploration concessions were a major development in 1976. Las Mercedes de Petrolera of Venezuela was close to signing a contract for exploration in the region around the city of Azua on the Caribbean coast, where oil was known to exist.

The Dominican Republic became virtually self-sufficient in cement by yearend 1976. Cement capacity was expected to reach 42 million bags annually in the near future, making the country a net exporter of cement.

Table 9.—Dominican Republic: Exports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS			
Aluminum, bauxite ore and concentrate, gross weight [2]		1,473,588	909,906
Copper metal, scrap		462	298
Gold and silver metal (dore bars) [2]	thousand troy ounces	--	272
Iron and steel, ferronickel [2]		79,835	63,074
Nickel metal, scrap		94	15
NONMETALS			
Clay products, refractory	value, thousands	$53	--
Fertilizer materials, manufactured	do	$288	NA
Gypsum and plasters	do	$924	$2,438
Stone, calcareous		32,090	NA

NA Not available.

[1] Unless otherwise specified, data are derived from import statistics of selected trading partner countries.

[2] Banco Central de la República Dominicana. Boletin Mensual. V. 30, No. 1, January 1977.

Table 10.—Dominican Republic: Apparent imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS			
Aluminum metal, unwrought and semimanufactures		1,742	1,425
Copper metal, unwrought and semimanufactures		1,215	1,596
Iron and steel metal:			
Scrap		17,517	5,469
Pig iron and ferroalloys		1,008	663
Steel ingots and equivalent primary forms		4,144	26,565
Semimanufactures		104,806	82,551
Lead metal, unwrought and semimanufactures		166	159
Manganese ore and concentrate		490	--
Nickel metal, unwrought and semimanufactures	value, thousands	$46	--
Tin metal, unwrought and semimanufactures		15	--
Zinc metal:			
Blue powder		100	89
Unwrought and semimanufactures		475	251
Other:			
Oxides, hydroxides, peroxides of metals, n.e.s		316	304
Base metals including alloys, all forms, n.e.s		3	--
NONMETALS			
Abrasives, natural, grinding and polishing wheels and stones	value, thousands	$151	$61
Asbestos		1,380	667
Cement, hydraulic		79,376	74,095
Clays and clay products:			
Crude		811	1,341
Products:			
Nonrefractory		1,536	--
Refractory	value, thousands	$1,828	$2,178
Fertilizer materials:			
Crude		2,478	(2)
Manufactured:			
Nitrogenous		94,093	78,571
Phosphatic		14,864	6,805
Potassic		35,399	19,128
Mixed		38,714	33,673
Gypsum and plasters		552	--
Magnesite	value, thousands	$65	$123
Sodium and potassium compounds		9,534	9,073
Stone, sand and gravel:			
Dimension stone, worked		78	--
Gravel and crushed stone		1,265	(3)
Talc and steatite		661	380
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline	thousand 42-gallon barrels	130	24
Distillate fuel oil	do.	281	206
Residual fuel oil	do.	837	1,311
Lubricants	do.	80	91
Other	do.	447	190
Total	do.	1,775	1,822

[1] Source of petroleum data is: U.S. Bureau of Mines, Division of Petroleum and Natural Gas. International Petroleum Annual. 1974 and 1975. All other figures are from export statistics of selected trading partner countries.

[2] Value only reported at $774,000.

[3] Value only reported at $80,000.

HAITI

The principal mining activity in Haiti continued to be in bauxite, carried out by Reynolds Haitian Mines, Inc. Although Reynolds considered its Miragoâne operations to be marginal, the company still produced and exported about 660,000 tons of bauxite in 1976. Negotiations for a new bauxite mining contract were in progress at yearend. The impasse was caused by an attempt by the Institut Nacional des Ressources Minerales (INAREM) to increase the tax rates significantly, which surprised Reynolds who expected a quick agreement on the terms of the contract.

Société Minière de Haiti S.A., a subsidiary of Kennecott Copper Corp., signed an agreement with the Government of Haiti to explore, initially for metal sulfide ores, in the Limbé District on the northeastern coast of Haiti.

The Haitian subsidiary of Peñarroya S.A., a French concern, instituted an exploration program adjacent to the Kennecott property, and was also involved in diamond drilling to delineate an ore body. The company negotiated an agreement with the Haitian Government whereby a 40% participation would be reserved for the Government in any commercial development resulting from the exploration work.

The Government and Southern Cross Petroleum Co. of the United States signed a contract for the exploration, production, and marketing of petroleum. The contract called for four wells to be drilled offshore, the first within 1 year. The revenue was to be split between INAREM (60%) and Crux, Ltd., the wholly owned subsidiary of Southern Cross that was to operate the project (40%).

Table 11.—Haiti: Foreign trade in mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations/ sources, 1975
EXPORTS			
Aluminum	809,883	522,707	All to United States.
Cement	--	1,633	Mainly to Cayman Islands.
Iron and steel scrap	115	74	United States 37; West Germany 20; Netherlands 17.
IMPORTS			
METALS			
Aluminum metal, all forms	381	328	Belgium-Luxembourg 138; United States 129; Austria 47.
Copper metal, all forms	22	20	United States 9; United Kingdom 8.
Iron and steel:			
Ore and concentrate	43	23	All from United States.
Metal:			
Scrap	15	5	United States 3; Bahamas 1.
Semimanufactures [2]	18,612	14,660	Japan 4,761; United States 3,639; Belgium-Luxembourg 3,008.
Lead metal, all forms	1	31	United States 28; France 3.
Platinum-group metals and silver:			
Ores and concentrates, kilograms	--	68	All from United States.
Metals including alloys:			
Platinum-group, troy ounces	96	64	Do.
Silver, do	--	129	All from France.
Tin metal, all forms	459	333	United States 217; France 115.
Other:			
Ores and concentrates	3	2	Mainly from United States.
Base metals including alloys, all forms	30	(3)	All from United States and Belgium-Luxembourg.
NONMETALS			
Abrasives, natural, grinding and polishing wheels and stones	7	5	Mainly from United States.
Asbestos, crude	--	1	All from United States.
Cement	1,390	924	Denmark 380; Belgium-Luxembourg 234; France 168.

See footnotes at end of table.

Table 11.—Haiti: Foreign trade in mineral commodities [1]—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations/ sources, 1975
IMPORTS—Continued			
Clays:			
Crude	79	104	United States 61; Mexico 26; Netherlands 17.
Manufactured products	703	989	United States 508; Italy 137; Japan 115.
Feldspar, fluorspar, cryolite, chiolite	--	(3)	All from United States.
Fertilizer materials:			
Crude:			
Phosphatic	16	8	Do.
Potassic	30	36	Do.
Manufactured, nitrogenous	600	168	Mainly from United States.
Mica, worked and unworked, including splittings and waste	r 5	11	United States 8; Brazil 2.
Pigments, mineral, natural	139	164	United States 73; West Germany 36; Belgium-Luxembourg 25.
Salt	304	140	Jamaica 114; United States 20.
Stone, sand and gravel:			
Stone:			
Dimension, worked and partly worked	r 126	31	Mainly from Italy.
Industrial, except dimension	43	1,644	Mainly from Dominican Republic.
Limestone	6	(3)	All from United States.
Sand and gravel, including crushed quartz	202	334	Netherlands 206; United States 128.
Sulfur, elemental	--	15	Mainly from United States.
Other:			
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	370	208	France 112; Belgium-Luxembourg 95.
Nonmetallic minerals, worked and unworked, n.e.s	4	(3)	All from United States.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural	683	905	Jamaica 417; Japan 372; United States 104.
Coal, coke, agglomerates	47	14	All from United States.
Petroleum refinery products:			
Gasoline—thousand 42-gallon barrels	100	82	Mainly from Netherlands Antilles.
Kerosine—do	16	5	Do.
Distillate fuel oil—do	675	572	Do.
Lubricants—do	13	22	United States 10; Netherlands Antilles 8.
Other:			
Liquefied petroleum gas—do	r 21	18	Panama 13; Colombia 2; United States 2.
Mineral waxes—do	1	1	Mainly from United States and West Germany.
Bituminous mixtures, n.e.s—do	(3)	1	Mainly from Jamaica.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r 7	14	Mainly from United Kingdom.

r Revised.
[1] Data are for years ending September 30 of that stated.
[2] Includes small quantities of pig iron, ferroalloys, and crude steel.
[3] Less than ½ unit.

JAMAICA

The general election of 1976, resulting in the success of the People's National Party, clarified some investment uncertainties and led to endorsement of the policy of greater Governmental participation in the affairs of the bauxite and alumina industry. Declining exports caused a record high balance-of-trade deficit, and labor problems impeded production. Revenue derived from the operations of the five North American companies engaged in mining and refining in Jamaica fell during 1976 to $132 million, compared with $158 million in 1975.

The alumina plant of Alcoa Minerals of Jamaica, Inc., was shut down for two 3-month periods during 1976. Labor disputes caused Alcoa to suspend operations from mid-February to early May. Two months later an explosion at the plant caused the second shutdown. The plant was reopened in October and operated at one-half of capacity the remainder of the year.

During 1976, the Government continued its negotiations with the mining companies for the purchase of a 51% interest in their assets. In October, an agreement was signed between Alcoa and the Government to form a joint bauxite and alumina venture to be known as Jamalco. Under the 40-year agreement, Alcoa will sell to the Government a 6% interest in its mining and refining assets and all of its mining and nonoperating landholdings. Collectively, this was estimated to represent a transfer of 51% of Alcoa's assets on the island. In addition, the joint operating concern would enjoy a reduced bauxite levy rate of 7.5% compared with the general rate of 8.5%. At the end of 8 years, a new rate would be negotiated. Negotiations for a similar partnership between Kaiser Bauxite Co. and the Government were also completed, due to take effect in February 1977. Agreements with Reynolds Jamaica Mines Ltd. and Alcan Jamaica Ltd. had not been concluded at the end of 1976.

The alumina plant and mines of Revere Jamaica Alumina, Ltd., were closed down in August 1975 and remained closed throughout 1976. Revere initiated a suit against the Government challenging the validity of the bauxite production levy as applied to Revere, and sought confirmation that its mining lease remained valid. Revere also filed a claim with the Overseas Private Investment Corp., a U.S. Government insurance agency, under the expropriation provisions. Neither of these actions had been resolved by yearend.

During 1976, Hungarian Aluminium Corp. completed a feasibility study of a new alumina plant in Manchester Parish. Negotiations were begun with the five North American companies for transport rights of bauxite and alumina on behalf of the newly formed Jamaican Merchant Marine. Construction of the joint Jamaican-Mexican 150,000-ton-per-year aluminum smelter to be constructed in Mexico was expected to commence in early 1977 with production coming onstream by 1983.

The Government established a new organization to oversee all aspects of petroleum refining and associated industries in Jamaica. The new organization, to be called the Petroleum Company of Jamaica Ltd., was a merger of National Oil Corp. and Luana Development Company. The new company's primary tasks were to implement plans to set up an 80,000-barrel-per-day refinery near Luana, in southwestern Jamaica, and to incorporate under Government management the existing 32,000-barrel-per-day Esso West Indies Ltd. refinery, which the Government planned to take over.

Table 12.—Jamaica: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite and concentrate --thousand tons--	8,000	5,483	All to United States.
Alumina ----------do----	2,816	2,405	United States 709; Norway 543; United Kingdom 478.
Metal including alloys:			
Scrap	731	668	Mainly to United States.
Unwrought and semimanufactures	844	444	Trinidad and Tobago 140; Martinique 69; Barbados 68.
Copper:			
Copper sulfate	34	1	All to Haiti.
Metal including alloys:			
Scrap	71	125	West Germany 102; United Kingdom 23.
Unwrought and semimanufactures	40	23	All to West Germany.
Iron and steel metal:			
Scrap	678	181	All to United States.
Steel, primary forms	335	97	Trinidad and Tobago 61; Guyana 34.
Semimanufactures [1]	1,828	1,196	Trinidad and Tobago 923; Guyana 131.
Lead metal including alloys:			
Scrap	240	(2)	All to United Kingdom.
Unwrought and semimanufactures	44	4	All to United States.
Platinum-group metals including alloys, unwrought and semimanufactures value, thousands--	--	$3	All to Canada.
Silver metal including alloys, unwrought and semimanufactures ----troy ounces--	1,400	NA	
Tin metal including alloys:			
Scrap	r 1,142	1,699	Mainly to United States.
Unwrought and semimanufactures	--	35	United States 23; United Kingdom 12.
Zinc metal including alloys, unwrought and semimanufactures	--	414	Trinidad and Tobago 228; Guyana 50; Antigua 45.
Other:			
Ash and residue containing nonferrous metals	82	42	United States 24; United Kingdom 17.
Nonferrous metal scrap, n.e.s	1,153	65	All to United Kingdom.
Metals including alloys, unwrought and semimanufactures, n.e.s	90	--	
NONMETALS			
Abrasives	(2)	(2)	All to United States.
Cement, hydraulic	619	(2)	Mainly to Cayman Islands and Belize.
Clays and clay products:			
Crude	--	54	Mainly to Trinidad and Tobago.
Products, refractory [3]	44	1	All to United States.
Fertilizer materials:			
Manufactured:			
Nitrogenous	46	5	All to Cayman Islands.
Potassic	20	--	
Mixed	224	2	All to Belize.
Ammonia	(2)	(2)	All to United States.
Gypsum and plasters	219,449	248,366	Do.
Lime	949	1,712	Guyana 1,042; Barbados 461; Trinidad and Tobago 207.
Mica, crude and manufactured	49	46	United States 31; Barbados 11.
Salt	234	8,440	Mainly to Haiti.
Stone, sand and gravel:			
Dimension stone, crude and worked	(2)	2	Mainly to Cayman Islands.
Gravel and crushed stone	47	10	Mainly to Barbados.
Sodium compounds, n.e.s.:			
Sodium carbonate	(2)	--	
Caustic soda	--	5	Antigua 2; Netherlands Antilles 2.
Sulfuric acid	150	1,838	Mainly to Cuba.
Talc	--	6	All to Trinidad and Tobago.
Other:			
Crude	(2)	--	
Slag, dross, and similar waste, not metal bearing	--	15	All to United Kingdom.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	3,811	283	Guyana 239; United States 44.

See footnotes at end of table.

Table 12.—Jamaica: Exports and reexports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	1,535	1,565	All to Haiti.
Coke and semicoke ---value	$66	--	
Hydrogen, helium, rare gases	9	31	Mainly to Trinidad and Tobago.
Petroleum:			
Crude ---thousand 42-gallon barrels	(2)	--	
Refinery products:			
Gasoline ---do	4	19	Mainly to Cayman Islands.
Jet fuel and kerosine ---do	(2)	--	
Distillate fuel oil ---do	249	147	Panama 61; Belize 32; Cayman Islands 29.
Residual fuel oil ---do	147	195	Mainly to United States.
Lubricants ---do	154	151	Guatemala 17; Panama 16; Guyana 15.
Other:			
Liquefied petroleum gas ---do	(2)	(2)	Mainly to Trinidad and Tobago.
Nonlubricating oils, n.e.s ---do	(2)	(2)	Mainly to Cayman Islands.
Pitch and asphalt ---do	9	30	Haiti 9; Netherlands Antilles 6; Guyana 5.
Bitumen ---do	4	20	Mainly to Haiti.
Total ---do	567	562	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	1	--	

r Revised. NA Not available.
[1] Partial figures; exclude quantities valued at $443 in 1974 and $3,324 in 1975.
[2] Less than ½ unit.
[3] Partial figures; exclude quantities valued at $611 in 1974 and $826 in 1975.

Table 13.—Jamaica: Imports of mineral commodities

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite	(1)	--
Oxide and hydroxide	34	6
Metal including alloys, unwrought and semimanufactures	3,518	3,072
Copper:		
Copper sulfate	15	2
Metal including alloys, unwrought and semimanufactures	1,200	853
Gold metal, unworked or partly worked ---value, thousands	(2)	--
Iron and steel metal:		
Scrap	12	6
Pig iron, ferroalloys, similar materials	723	553
Steel, primary forms	13,430	22,861
Semimanufactures	88,705	57,771
Lead metal including alloys, unwrought and semimanufactures	231	278
Magnesium metal including alloys, semimanufactures	(1)	(1)
Manganese ore and concentrate	44	164
Nickel metal including alloys, unwrought and semimanufactures	500	474
Platinum-group metals and silver:		
Ores and concentrates ---value	$100	--
Waste and sweepings ---do	$1,544	$119
Metals including alloys:		
Platinum-group ---do	$27,479	$3,692
Silver ---do	$877,410	$692,695
Tin metal including alloys, unwrought and semimanufactures	9,259	5,582
Tungsten metal including alloys, unwrought and semimanufactures	1	(1)
Uranium and thorium metals including alloys, unwrought and semimanufactures	(1)	3
Zinc metal including alloys:		
Blue powder	8	28
Unwrought and semimanufactures	701	1,211
Other:		
Ores and concentrates, n.e.s	--	17
Nonferrous metal scrap, n.e.s	2	2
Nonferrous metals, n.e.s., unwrought and semimanufactures	16	8
NONMETALS		
Abrasives, natural:		
Pumice, emery, natural corundum, etc	20	10
Dust and powder of precious and semiprecious stones ---value	$978	$902
Grinding and polishing wheels and stones	53	1
Asbestos, crude, washed or ground	1,680	1,307
Barite, natural	26	(1)
Boron, crude, natural	2	(1)
Cement, hydraulic	29,643	11,144
Chalk	21	6
Clays and clay products:		
Crude	744	761
Products:		
Nonrefractory	4,926	5,580
Refractory [3]	241	6,779
Diamond:		
Gem, not set or strung ---value, thousands	$105	$90
Industrial ---do	$1	$5
Diatomite and other infusorial earth	223	102
Feldspar, fluorspar, cryolite, chiolite, nepheline syenite	105	171
Fertilizer materials:		
Crude:		
Nitrogenous	(4)	--
Phosphatic	379	2,561
Manufactured:		
Nitrogenous	31,631	29,993
Phosphatic	9,370	4,437
Potassic	16,164	21,529
Mixed	10	4,857
Ammonia	88	70
Graphite, natural	1	2
Gypsum and plasters	517	82
Lime	85	239
Magnesite, crude	2	--
Mica:		
Crude	135	165
Worked	98	9
Pigments, natural, crude	91	105
Precious and semiprecious stones ---value, thousands	$66	$177
Salt	22,755	16,065
Sodium compounds, n.e.s.:		
Sodium carbonate	4,406	7,329
Sodium hydroxide	454,243	494,182

See footnotes at end of table.

Table 13.—Jamaica: Imports of mineral commodities—Continued

Commodity		1974	1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone		495	597
Gravel and crushed stone		323	112
Limestone (except dimension)		2,177	813
Quartz, unground		(5)	2
Sand, including ground quartz		167	214
Sulfur:			
Elemental		330	4,951
Sulfur dioxide		3	21
Sulfuric acid		53	412
Talc, steatite, soapstone, pyrophyllite		1,191	1,051
Other:			
Crude		11	18
Slag, dross, and similar waste, not metal bearing		(1)	--
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s		2,602	833
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		950	379
Carbon gas		1,374	81,081
Coal and briquets		114	61
Coke and semicoke		743	25,625
Hydrogen, helium, rare gases		20	32
Peat, including peat briquets and litter	value	$211	$1,267
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	10,969	10,399
Refinery products:			
Gasoline	do	508	543
Jet fuel and kerosine	do	291	158
Distillate fuel oil	do	1,147	490
Residual fuel oil	do	5,944	7,882
Lubricants	do	165	104
Other:			
Liquefied petroleum gas	do	116	155
Petroleum jelly and wax	do	13	9
Nonlubricating oils, n.e.s	do	5	1
Asphalt, bitumen, pitch, pitch coke	do	(6)	5
Petroleum coke	do	(1)	2
Total	do	8,189	9,349
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		475	229

[1] Less than ½ unit.
[2] Revised to none.
[3] Partial figures; exclude quantities valued at $453,305 in 1974 and $1,041,846 in 1975.
[4] Value only reported at $245.
[5] Value only reported at $3,045.
[6] Value only reported at $194,000.

MARTINIQUE AND GUADELOUPE

During 1976, the mineral industry of Martinique continued to be centered around the production of marine salt, fertilizers, and cement, all of which were consumed domestically. Clays and construction aggregates were also mined for domestic consumption. Martinique's petroleum refinery, S.A. de la Raffinerie des Antilles, at Fort-de-France, had a capacity of 11,000 barrels per day. The principal refinery products were gasoline and residual and distillate fuel oil. Almost 40% of the petroleum products were exported.

The economy of Guadeloupe was in a depressed state, but subsidies and transfer payments by the French Government alleviated the situation. The mineral industry of Guadeloupe consisted of construction aggregates for domestic consumption. No official statistics for these products were reported in 1976.

Table 14.—Martinique: Foreign trade in selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
EXPORTS		
Cement	5,732	--
Copper scrap	188	--
Iron and steel scrap	1,728	--
Petroleum refinery products:		
Gasoline ---thousand 42-gallon barrels	358	396
Kerosine ---do	510	471
Distillate fuel oil ---do	179	154
Residual fuel oil ---do	233	260
Other: Liquefied petroleum gas ---do	82	80
IMPORTS		
Aluminum metal including alloys, all forms	132	114
Cement ---thousand tons	112	71
Clay products:		
Refractory	44	126
Nonrefractory	5,890	5,133
Copper metal including alloys, all forms	61	46
Fertilizers, manufactured:		
Nitrogenous	4,490	5,366
Phosphatic	1,577	1,105
Potassic	2,589	1,918
Other, including mixed	19,347	16,252
Petroleum:		
Crude ---thousand 42-gallon barrels	5,137	2,860
Refinery products:		
Lubricants ---do	32	23
Liquefied petroleum gas ---do	4	--
Salt	2,363	2,377
Stone, sand and gravel	8,345	--

Table 15.—Guadeloupe: Foreign trade in selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
EXPORTS		
Iron and steel scrap	3,071	--
IMPORTS		
Aluminum metal including alloys, all forms	426	448
Cement ---thousand tons	117	108
Clay products:		
Refractory	202	140
Nonrefractory	14,398	5,827
Copper metal including alloys, all forms	68	90
Fertilizers, manufactured:		
Nitrogenous	--	1,479
Phosphatic	1,318	--
Other, including mixed	19,407	15,386
Iron and steel semimanufactures:		
Bars, rods, angles, shapes, sections	11,297	10,593
Universals, plates, sheets	2,855	2,644
Hoop and strip	--	204
Wire	975	720
Tubes, pipes, fittings	7,782	8,226
Castings and forgings, rough	--	148
Petroleum refinery products:		
Gasoline ---thousand 42-gallon barrels	402	411
Kerosine ---do	76	64
Distillate fuel oil ---do	148	165
Residual fuel oil ---do	257	275
Other:		
Liquefied petroleum gas ---do	89	103
Lubricating oil ---do	23	24
Salt	2,497	2,617
Stone and sand and gravel, crude	9,715	4,411

NETHERLANDS ANTILLES

The petroleum industry continued to play a major role in the economy of the Netherlands Antilles. Thus, the slow recovery of most Western nations from the recession of 1974–75 had an adverse effect on the country's economy. The Government remained convinced that the lack of natural resources in the country makes it imperative that more industry be attracted to provide a firm economic base for the area. Thus, it was making every effort to attract more industry and to protect such industries once they were established.

Petroleum products from the two 500,000-barrel-per-day refineries on Aruba and Curaçao normally account for about 90% of the country's international trade. During 1976, however, owing to the conditions in the international oil market, neither refinery was producing at capacity. It was estimated that the Shell Curaçao N.V. refinery operated at 50% capacity, and Exxon's Lago refinery on Aruba operated at 60% capacity. According to company officials, the U.S. energy programs operated to the disadvantage of the two refineries, because they could not compete successfully in the U.S. market with Hess Oil Virgin Islands Corp. at St. Croix, which was treated favorably as a domestic U.S. refinery. The Shell Curaçao refinery in particular maintained only 15% of its former U.S. market at the end of 1976 and was experiencing substantial losses and reduced output. However, the oil transshipment terminals were flourishing. An oil storage facility was also being constructed on St. Eustatius.

Preliminary exploration for possible petroleum deposits was conducted off the coast of Saba by Marathon Oil Co. Contracts were signed with a consortium for further exploration off Saba as well as offshore between Aruba and Curaçao. The consortium, known as the Seagap Group, was composed of Getty Oil Co. (operator), Phillips Petroleum Co., Hispanoil, and Agip S.p.A.

Table 16.—Netherlands Antilles: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, all forms	--	1
Copper metal including alloys, all forms	17	2
Iron and steel metal:		
Scrap	4,688	1,790
Semimanufactures	179	133
Lead metal including alloys	2	--
Platinum-group metals and silver ---value, thousands	$547	$1
Other:		
Ores and concentrates	740	--
Nonferrous metals including alloys, all forms	2,073	1,625
NONMETALS		
Fertilizers, crude, phosphatic ---thousand tons	107	54
Salt and brine ---do---	65	59
Stone, sand and gravel	(1)	2
Sulfur	73,053	70,669
Other	--	46,376
MINERAL FUELS AND RELATED MATERIALS		
Petroleum: [2]		
Crude ---thousand 42-gallon barrels	--	7,802
Refinery products:		
Gasoline:		
Aviation ---do---	--	1,487
Other ---do---	13,058	8,321
Jet fuel ---do---	20,011	13,560
Kerosine and white spirit ---do---	1,016	744
Distillate fuel oil ---do---	20,413	23,544
Residual fuel oil ---do---	149,129	116,557
Lubricants ---do---	3,571	2,167
Other ---do---	31,111	18,005
Total ---do---	238,309	184,385

[1] Value only reported at $500.

[2] U.S. Bureau of Mines, Division of Petroleum and Natural Gas. International Petroleum Annual. 1974 and 1975.

Table 17.—Netherlands Antilles: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, all forms	411	348
Copper:		
Copper sulfate	7	--
Metal including alloys, all forms	445	357
Iron and steel metal:		
Scrap	13	--
Semimanufactures	31,760	27,632
Lead metal including alloys, all forms	42	182
Nickel metal including alloys, all forms	3	18
Silver metal including alloys, all forms ---value, thousands	$102	$74
Tin metal including alloys, all forms	11	29
Zinc metal including alloys, all forms	324	162
Other:		
Nonferrous metal scrap, n.e.s	2	2
Base metals including alloys, n.e.s	22	10
NONMETALS		
Abrasives, natural, n.e.s.:		
Pumice, emery, natural corundum, industrial diamond	16	4
Grinding and polishing wheels and stones	24	159
Cement	61,293	79,843
Clays and clay products (including all refractory brick):		
Crude	394	814
Products	9,631	6,215
Diamond, gem, not set or strung ---carats	2,040	1,205
Fertilizer materials:		
Crude	1	2
Manufactured	893	656
Gypsum and plasters	58	31
Lime	695	115
Mica, worked, including agglomerated splittings	3	--
Precious and semiprecious stones, except diamond ---troy ounces	225	138
Salt	974	778
Sodium and potassium compounds:		
Sodium carbonate	38	73
Caustic soda	26,679	12,522
Stone, sand and gravel:		
Dimension stone, worked and unworked	779	664
Crushed rock and sand	25,603	17,530
Sulfuric acid	9,705	16,555
Other, crude	6,612	2,090
MINERAL FUELS AND RELATED MATERIALS		
Coal and coke and briquets	21	15
Hydrogen, helium, rare gases	101	3,472
Petroleum:[1]		
Crude ---thousand 42-gallon barrels	296,036	211,181
Refinery products:		
Gasoline, all grades ---do	--	1,334
Jet fuel ---do	--	64
Distillate fuel oil ---do	217	1,321
Lubricants ---do	68	35
Other ---do	1,132	1,259
Total ---do	1,417	4,013
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	9	15

[1] U.S. Bureau of Mines, Division of Petroleum and Natural Gas. International Petroleum Annual. 1974 and 1975.

TRINIDAD AND TOBAGO

The economy of Trinidad and Tobago registered a real growth of almost 5% in 1976. On May 28, the Trinidadian and Tobagan dollar's (TT$) traditional link with sterling was severed and substituted with a tie to the U.S. dollars at the rate of TT$2.40=US$1.00, an effective devaluation of 20% from the historical exchange rate. The new link with the U.S. dollar was expected to provide an element of stability for businessmen trading with the United States and other nonsterling countries.

Although Trinidad and Tobago did not have a formal development plan, the Government's development strategy was broadly defined. With the added revenues generated by the post-1973 petroleum price increases, the Government intended to develop oil- and gas-related basic industries. A fertilizer plant scheduled to come onstream in 1977 was expected to double the country's existing capacity. The feasibility of building a liquid natural gas plant was also under study. Other projects at various stages of planning included a methanol plant and an aluminum smelter.

Reversing the trend of recent times, petroleum output fell slightly during the year, from an average of 215,000 barrels per day in 1975 to 212,000 barrels per day in 1976. The decline was attributed to a severe fire in the processing area of Amoco's Galeota Point terminal in southeastern Trinidad where the onshore facilities for receiving marine crude were located, causing a 2-week shutdown of operations. There have been no significant oil discoveries in Trinidad and Tobago since Amoco discovered the Teak, Somaan, and Poui Fields in 1972. Amoco, which produced more than half of Trinidad and Tobago's petroleum, expected production to begin to decline soon. The Trinidad Northern Areas Ltd. consortium, consisting of Texaco Inc., Trinidad and Tobago Oil Co. Ltd. (Trintoc), and Tesoro Petroleum Corp., had the second largest share of petroleum production. During 1976, the companies lifted an average of 49,000 barrels of oil per day. As a result of the tax cut on petroleum products enacted in 1976, the major oil companies were expected to increase their investment in secondary recovery techniques.

Natural gas began to replace petroleum as Trinidad and Tobago's major mineral resource. Gas production rose to 375 million cubic feet per day, 11% above that of 1975. Offshore exploration during the past 15 years yielded substantial gas reserves, which in 1976 were estimated at 9 trillion cubic feet, twice the previous year's estimate. Texaco made a gas discovery off the eastern coast on a 305,000-acre block but was awaiting Government assurance that the gas would be available for export before it begins development.

The proposed direct-reduction steel plant of the newly formed Iron and Steel Co. of Trinidad and Tobago at Point Lisas received a setback in 1976 with the withdrawal of Kawasaki Steel Corporation and Mitsui & Co., Ltd., both of Japan, which had 11.5% and 5% interests, respectively, in the venture. Consequently, planned capacity was cut back from an annual 1.2 million tons to 450,000 tons. Also, the pipeline that was to bring in natural gas for use as a reductant was behind schedule, leaving some doubt as to the proposed startup date of 1978.

Table 18.—Trinidad and Tobago: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum metal including alloys, all forms	73	51
Copper metal including alloys, all forms	r 550	455
Iron and steel metal:		
Scrap	r 13,685	1,427
Steel, primary forms	45	7
Semimanufactures	r 4,538	1,516
Lead:		
Ore	93	54
Oxide	30	25
Metal including alloys, all forms	r 1,600	1
Platinum waste and sweepings ---troy ounces	r 2,900	3,246
Silver metal including alloys ---do	6,768	9,677
Tin metal including alloys, all forms	221	(1)
Zinc metal including alloys, all forms	15	(1)
Other:		
Ash and residue containing nonferrous metals	18	--
Metals including alloys, all forms	(1)	--
NONMETALS		
Barite	18	7,067
Boron materials, crude natural borates	666	--
Cement, hydraulic ---value, thousands	$2,139	$2,206
Clays and clay products (including all refractory brick) [2]	r 747	105
Diatomite and other infusorial earth	--	18
Fertilizer materials:		
Manufactured:		
Nitrogenous	135,022	108,816
Other, including mixed	r 47	86
Ammonia	223,623	200,078
Lime	r 1,994	2,029
Salt	r 313	113
Sodium and potassium compounds	r 39	5
Stone, sand and gravel:		
Dimension stone:		
Crude	r 271	1,798
Worked	(1)	(1)
Gravel and crushed stone	31	(1)
Sand	21	99
Sulfuric acid, including oleum	8,893	560
Talc	1	--
Other	--	(1)
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	44,821	30,938
Coal, coke, peat	1	--
Hydrogen, helium, rare gases	(1)	4
Petroleum:		
Crude and partly refined ---thousand 42-gallon barrels	47,474	55,135
Refinery products:		
Gasoline ---do	17,413	6,472
Jet fuel ---do	7,488	2,901
Kerosine ---do	6,578	3,824
Distillate fuel oil ---do	12,804	9,400
Residual fuel oil ---do	63,500	40,665
Lubricants ---do	1,202	498
Other ---do	1,605	183
Total ---do	110,590	63,943
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	171,308	99,136

r Revised.
[1] Less than ½ unit.
[2] Partial figures; exclude quantities valued at $5,786 in 1974 and $1,662 in 1975.

Table 19.—Trinidad and Tobago: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Alumina	--	302
Metal including alloys, all forms	r 741	838
Arsenic trioxide, pentoxide, acid	(1)	(1)
Copper:		
Copper sulfate	27	23
Metal including alloys, all forms	r 1,949	1,136
Iron and steel metal:		
Scrap	127	--
Pig iron, ferroalloys, similar materials	r 12	22
Steel, primary forms	r 4,434	5,437
Semimanufactures:		
Bars, rods, angles, shapes, sections	r 32,535	22,110
Universals, plates, sheets	r 36,010	32,536
Hoop and strip	303	273
Rails and accessories	6	16
Wire	r 3,553	54,294
Tubes, pipes, fittings	r 1,068,500	141,980
Castings and forgings	r 122	5
Lead:		
Oxide	236	108
Metal including alloys, all forms	r 516	618
Nickel metal including alloys, all forms	19	542
Platinum-group and silver metals including alloys:		
Platinum-group ---troy ounces	42	1,686
Silver ---do	r 155,221	87,692
Tin metal including alloys, all forms	28	36
Titanium ore and concentrate	--	30
Zinc metal including alloys, all forms	r 1,030	117
Other metals including alloys, all forms	r 15	23
NONMETALS		
Abrasives, natural, n.e.s	r 77	41
Asbestos	57	76
Barite and witherite	r 15,054	30,548
Cement	2,709	3,515
Chalk	263	465
Clays and clay products (including all refractory brick):		
Crude	r 1,754	3,634
Products [2]	r 2,757	2,459
Diamond ---carats	r 13,608	37,945
Diatomite and other infusorial earth	22	67
Feldspar	982	314
Fertilizer materials:		
Natural	--	322
Manufactured:		
Nitrogenous	103	44
Phosphatic	r 1,120	1,372
Potassic	27,043	4,373
Other, including mixed	1,065	271
Ammonia	24,910	63,473
Gypsum	r 13,613	14,878
Lime	412	1,472
Magnesite	8	5
Mica, all forms	r 62	40
Pigments, mineral	r 22	5
Precious and semiprecious stones, except diamond, natural and manufactured ---carats	r 2,120	55,520
Salt	r 59,366	237,817
Sodium and potassium compounds, n.e.s.:		
Sodium hydroxide	4,680	5,344
Potassium hydroxide and sodic and potassic peroxides	r 45	36
Stone, sand and gravel:		
Dimension stone:		
Crude	r 3,512	3,130
Worked	21	26
Gravel and crushed stone	r 1,269	643
Sand	89	252
Sulfur:		
Elemental	22	16
Sulfuric acid	1,668	581
Talc	567	135
Other, crude	r 34	16

See footnotes at end of table.

Table 19.—Trinidad and Tobago: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		30	63
Coal and coke and briquets		r 138	320
Hydrogen, helium, rare gases		114	130
Peat		23	195
Petroleum:			
Crude and partly refined	thousand 42-gallon barrels	107,502	56,759
Refinery products:			
Gasoline	do	r (1)	(1)
Kerosine and jet fuel	do	r (1)	(1)
Distillate fuel oil	do	76	--
Residual fuel oil	do	563	90
Lubricants	do	r 76	195
Liquefied petroleum gas	do	r (1)	29
Mineral jelly and wax	do	r 11	9
Other	do	r 119	2
Total	do	r 845	325
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		r 47	89

r Revised.
1 Less than ½ unit.
2 Partial figures; exclude quantities valued at $195,455 in 1974 and $558,341 in 1975.

The Mineral Industry of Central American Countries

By Nicholas G. Theofilos [1]

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BELIZE

The only mining activity in Belize during 1976 involved the production of construction aggregates, which were used domestically. A comprehensive ordinance regulating mineral prospecting and mining was proposed during the year. Under the ordinance, which would supersede all grants and titles, ownership and control of all minerals except petroleum would be vested in the Government.

Exxon Corp. entered into an agreement with three oil companies to achieve a majority interest in nine oil prospecting leases covering 1 million acres, mostly offshore Belize. The agreement was with Weatherford International Inc. which had 30% interest in the leases, Ajax Petroleum Co. with 40% interest, and Canadian Superior Oil Ltd. with 24% interest. A new entity, Esso Ventures Inc., was established to be responsible for conducting extensive geophysical operations and drilling an exploratory well offshore Belize.

[1] Foreign mineral specialist, International Data and Analysis.

Table 1.—Central American Countries: Production of mineral commodities

(Metric tons unless otherwise specified)

Area and commodity	1974	1975	1976 p
BELIZE e			
Limestone	246,000	263,000	1,200,000
Marl	30,000	38,000	365,000
Sand and gravel	383,000	334,000	120,000
COSTA RICA			
Cement	297,922	329,677	361,988
Clays:			
Kaolin	225	277	500
Refractory ---cubic meters	694,440	NA	NA
Other ---do	100,000	NA	NA
Diatomite	31,400	e 32,000	717
Fertilizer materials, manufactured:			
Nitrogenous, gross weight	43,243	NA	45,530
Mixed and unspecified, gross weight	27,157	NA	741
Gold ---troy ounces	18,000	e 18,000	e 9,600
Lime	21,750	15,000	e 15,000
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	604	502	363
Kerosine ---do	133	168	160
Distillate fuel oil ---do	1,319	455	440
Residual fuel oil ---do	614	714	720
Pumice ---cubic meters	3,115	3,000	2,000
Salt, marine	13,605	15,711	20,000
Silver ---troy ounces	3,000	e 3,000	e 1,600
Stone, sand and gravel:			
Crushed rock and rough stone [1] ---cubic meters	r 1,060,000	950,000	450,000
Limestone and other calcareous material	384,321	134,587	52,000
Marble ---cubic meters	5,900	NA	NA
Marine shell ---do	13,000	NA	NA
Quartzite ---do	2,660	NA	NA
Sand and gravel ---do	210,000	215,000	190,000
Silica sands ---do	15,000	NA	NA
EL SALVADOR			
Aluminum metal, semimanufactures	2,064	1,361	1,621
Cement	291,400	331,815	322,165
Fertilizers, manufactured:			
Nitrogenous	NA	98,547	13,095
Phosphatic	NA		20,601
Mixed	100,052		112,533
Gold, fine ---troy ounces	6,022	8,713	3,007
Gypsum e	6,000	6,000	6,000
Iron and steel, steel semimanufactures	20,112	25,049	21,358
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	875	980	1,095
Kerosine ---do	248	NA	--
Jet fuel ---do	101	354	371
Distillate fuel oil ---do	1,207	1,489	1,469
Residual fuel oil ---do	1,610	1,459	1,763
Other:			
Liquefied petroleum gas ---do	185	215	147
Asphalt ---do	134	154	
Refinery fuel and losses ---do	65	228	237
Total ---do	4,425	4,879	5,082
Salt	26,013	23,000	e 23,000
Silver, fine ---troy ounces	167,900	176,496	166,289
Stone, limestone, seashell	e 400,000	503,621	486,016
GUATEMALA			
Antimony, mine output, metal content	436	856	1,120
Cement ---thousand tons	r 309	389	445
Clays:			
Bentonite ---cubic meters	2,402	NA	
Kaolin ---do	220	NA	(2)
Other ---do	28,068	NA	
Copper, content of concentrate	1,641	2,560	2,889
Feldspar	30,000	e 30,000	e 30,000
Gypsum	e 12,500	12,319	13,696
Iron ore, gross weight	e 4,536	6,000	2,578
Lead:			
Mine output, metal content e	100	100	100
Metal, including secondary	227	225	108
Lime	56,233	34,631	45,514
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	1,771	1,398	927
Kerosine and jet fuel ---do	658	536	446

See footnotes at end of table.

Table 1.—Central American Countries: Production of mineral commodities—Continued

(Metric tons unless otherwise specified)

Area and commodity	1974	1975	1976 p
GUATEMALA—Continued			
Petroleum refinery products—Continued			
Distillate fuel oil ——thousand 42-gallon barrels	2,069	1,595	1,298
Residual fuel oil ——do	2,063	1,875	1,875
Other:			
Liquefied petroleum gas ——do	101	76	68
Unspecified ——do	3	1	--
Refinery fuel and losses ——do	154	NA	573
Total ——do	6,819	5,481	5,187
Salt	8,884	8,800	10,924
Stone, sand and gravel:			
Crushed and broken:			
Limestone ——thousand tons	400	848	939
Volcanic ash ——do	32	15	24
Marble ——cubic meters	1,200	1,200	1,337
Quartz	14,400	NA	2,755
Sand and gravel ——cubic meters	418,000	792,041	868,369
Talc	11	NA	--
Tungsten concentrate (W content)	6	1	--
Zinc, mine output, metal content [3]	--	--	457
HONDURAS			
Antimony, mine output, metal content	135	103	117
Cadmium, mine ouput, metal content	217	230	231
Cement	214,747	298,000	222,170
Copper, mine output, metal content [4]	186	e 200	364
Gold ——troy ounces	2,124	2,520	2,280
Gypsum	8,509	1,050	e 1,000
Lead, mine output, metal content	18,784	23,263	18,590
Petroleum refinery products:			
Gasoline ——thousand 42-gallon barrels	704	716	701
Jet fuel ——do	71	86	77
Kerosine ——do	245	245	270
Distillate fuel oil ——do	1,217	1,223	1,368
Residual fuel oil ——do	1,788	1,949	891
Liquefied petroleum gas ——do	86	912	72
Refinery fuel and losses ——do	236	1,612	71
Total ——do	4,347	6,743	3,450
Salt	e 32,000	31,000	e 31,000
Silver ——thousand troy ounces	3,661	3,802	2,964
Stone, crushed and broken	315,465	NA	NA
Zinc ore and concentrate, metal content	23,960	30,298	24,850
NICARAGUA			
Cement	235,732	176,848	208,717
Copper, mine output, metal content	1,775	508	631
Gold, mine output, metal content ——troy ounces	82,639	70,281	75,855
Gypsum and anhydrite, crude e	35,000	35,000	15,000
Lead ore and concentrate, metal content	1,752	309	1,273
Lime e	39,000	46,000	45,000
Petroleum refinery products:			
Gasoline ——thousand 42-gallon barrels	1,166	1,197	1,373
Kerosine and jet fuel ——do	237	295	331
Distillate fuel oil ——do	1,153	1,150	1,231
Residual fuel oil ——do	1,328	1,608	1,650
Other:			
Liquefied petroleum gas ——do	161	155	188
Asphalt ——do	134	185	150
Unspecified ——do	64	52	67
Refinery fuel and losses ——do	87	253	251
Total ——do	4,330	4,895	5,241
Salt, marine e	10,000	12,000	14,000
Silver, mine output ——troy ounces	269,787	324,184	203,737
Stone, crushed and broken	e 400,000	NA	NA
Zinc ore and concentrate, metal content	8,837	6,327	14,287
PANAMA			
Cement	395,020	276,875	310,583
Clays and clay products:			
Crude	229,895	189,382	272,012
Products	110,000	60,000	(5)
Gold, fine ——troy ounces	11	NA	NA
Petroleum refinery products:			
Gasoline ——thousand 42-gallon barrels	2,858	2,915	2,343
Kerosine and jet fuel ——do	3,078	2,614	2,079

See footnotes at end of table.

Table 1.—Central American Countries: Production of mineral commodities—Continued
(Metric tons unless otherwise specified)

Area and commodity	1974	1975	1976 p
PANAMA—Continued			
Petroleum refinery products—Continued			
Distillate fuel oil ---thousand 42-gallon barrels--	4,424	4,787	4,626
Residual fuel oil ---do---	14,042	15,666	9,639
Other:			
Liquefied petroleum gas ---do---	339	398	346
Asphalt ---do---	93		101
Unspecified ---do---	571	1,100	407
Refinery fuel and losses ---do---	617	1,320	838
Total ---do---	26,022	28,800	20,379
Salt, marine	22,704	29,243	12,514
Stone, sand and gravel:			
Limestone [6]	527,032	20,589	211,381
Other ---thousand cubic meters--	e 3,034	1,729	398

e Estimate. p Preliminary. r Revised. NA Not available.
[1] In previous chapters, crushed rock and rough stone was reported as "Other" stone. The figures were erroneously reported in metric tons rather than in cubic meters.
[2] Total clay production for 1976 was 96,375 metric tons.
[3] Exports.
[4] From lead and zinc concentrates.
[5] Quantity reported as 45,128 cubic meters.
[6] 1975 and 1976 totals exclude an amount reported in volumetric units at 8,000 cubic meters.

COSTA RICA

In 1976, the economy of Costa Rica exhibited strong signs of recovery from the stagnation of 1975. Gross domestic product (GDP) real growth was calculated to be approximately 6%.

On November 12, Aluminum Co. of America (Alcoa) formally withdrew from its agreement with the Costa Rican Government to develop the bauxite deposits in the Boruca region after deciding that the economic feasibility of mining the deposits was marginal at best. However, Alcoa and Martin Marietta Aluminum, Inc., were exploring the possibility of constructing an aluminum smelter in Costa Rica to use imported alumina. The fate of the smelter depended upon successful financing for the Boruca hydroelectric project, which would supply the electricity.

Mining of gold and silver at Bulora Corp. Ltd.'s Libano mine continued. In 1976, 9,645 troy ounces of gold and 1,608 troy ounces of silver were produced.

United Hearne Resources Ltd., a Canadian company, took an option on 625 acres containing the Santa Clara mine from Barranca Corp., also of Canada. Trenching, diamond drilling, and bulk sampling confirmed earlier studies of a large low-grade gold-silver deposit grading 0.10 troy ounce of gold per ton.

Most of the country's electricity generation was hydroelectric, with the remainder coming from thermal stations using imported fuel. The Instituto Costarricense de Electricidad (ICE) was studying the possible development of geothermal energy in the Province of Guanacaste. Financing was to be partially provided by the Inter-American Development Bank.

In November, work started on a new cement plant at Colorado de Abangares. Financing was being provided by Spain. Production, to start in July 1979, was expected to be about 1,300 tons per day.

Table 2.—Costa Rica: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, unwrought and semimanufactures	176	331	Nicaragua 95; Guatemala 92; El Salvador 67.
Copper metal including alloys, all forms	5	--	
Iron and steel metal including alloys, all forms	8,635	7,641	Nicaragua 3,685; Panama 1,695; El Salvador 1,607.
Zinc metal including alloys, all forms	12	--	
Other nonferrous base metals including alloys, all forms [1]	65	58	Nicaragua 40; Panama 18.
NONMETALS			
Abrasives, natural, n.e.s.: Grinding and polishing wheels and stones	178	114	All to Nicaragua.
Cement	14	2,705	Do.
Clays and clay products (including nonclay refractory brick)	211	135	Nicaragua 99; Honduras 25.
Diatomite and other infusorial earth	7	780	All to El Salvador.
Fertilizer materials, manufactured:			
Nitrogenous	25,452	16,465	Mexico 13,475; Guatemala 1,575.
Potassic	--	80	All to Honduras.
Other, including mixed	44,716	51,209	Mexico 21,603; Nicaragua 10,067; Panama 5,578.
Lime	220	208	All to Panama.
Salt	(2)	--	
Stone:			
Dimension stone	77	76	Guatemala 40; Panama 29.
Other	2,438	1,409	Mainly to Panama.
Other building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	1,245	398	Panama 191; Nicaragua 127; Honduras 41.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline ----thousand 42-gallon barrels	(2)	(2)	All to bunkers.
Distillate fuel oil ----------do----	84	17	Do.
Lubricants ----------do----	(2)	(2)	All to Nicaragua.

[1] May include aluminum scrap.
[2] Less than ½ unit.

Table 3.—Costa Rica: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS [1]			
Aluminum metal including alloys, all forms	2,348	2,593	France 752; United States 598; El Salvador 252.
Copper:			
Copper sulfate	19	17	United Kingdom 12; West Germany 3.
Metal including alloys, all forms	1,764	1,565	Chile 448; Mexico 429; United States 361.
Iron and steel metal:			
Scrap	353	4	All from Panama.
Pig iron, ferroalloys, similar materials	327	428	Mainly from West Germany.
Steel, primary forms	27,521	28,854	United States 23,394; France 2,998.
Semimanufactures	r 89,712	60,274	Japan 23,148; United Kingdom 8,384; West Germany 7,509.
Lead metal including alloys, all forms	242	144	Denmark 58; United States 25; West Germany 22.
Nickel metal including alloys, all forms	12	6	United States 3; United Kingdom 1.
Platinum-group metals including alloys, all forms—troy ounces	10,963	8,649	All from United States.
Silver metal including alloys—do	32,858	8,906	Mainly from United States.
Tin metal including alloys, all forms	13	7	United States 5; Colombia 1.
Zinc metal including alloys, all forms	r 2,824	1,158	Mexico 916; Japan 134.
Other:			
Ores and concentrates of nonferrous base metals, n.e.s	552	502	Mexico 360; Japan 118.
Waste and scrap of nonferrous base metals	32	10	All from Panama.
Metals:			
Pyrophoric alloys	6	1	Mainly from Mexico.
Nonferrous base metals including alloys, all forms, n.e.s	12	16	Mainly from United States.
NONMETALS			
Abrasives, natural, n.e.s	102	79	United States 22; West Germany 18.
Asbestos	1,897	2,974	Canada 2,479; U.S.S.R. 350.
Boron materials, oxide and acid	23	45	West Germany 25; United States 20.
Cement	9,024	3,783	Japan 1,900; Belgium-Luxembourg 1,656.
Clays and clay products (including all refractory brick):			
Crude	1,821	1,763	United States 1,289; United Kingdom 259.
Products:			
Refractory (including nonclay bricks)	1,561	2,018	United States 704; Spain 619; Canada 393.
Nonrefractory	r 3,010	4,438	Panama 1,982; Nicaragua 1,951.
Diamond, industrial—carats	125,000	15,000	Mainly from United States.
Diatomite and other infusorial earth	433	300	Mainly from Mexico.
Feldspar, fluorspar, cryolite	785	311	Nicaragua 208; Guatemala 64.
Fertilizer materials:			
Crude, phosphatic and potassic	82	1	Mainly from West Germany.
Manufactured:			
Nitrogenous	r 60,487	49,358	Netherlands 13,629; Mexico 10,962; United States 7,280.
Phosphatic	60,910	56,329	United States 33,802; Mexico 12,559.
Potassic	45,752	47,296	United States 27,103; Canada 16,566.
Other, including mixed	1,716	5,615	United States 4,227; Netherlands 846.
Graphite, natural	2	8	United States 3; Canada 2; West Germany 2.
Lime	892	785	Mainly from Nicaragua.
Mica, all forms	13	17	Peru 12; West Germany 5.
Precious and semiprecious stones, including gem diamond—kilograms	37	2 45	Austria 30; West Germany 8.
Salt and brine	9,400	7,691	Mainly from Nicaragua.
Sodium compounds, n.e.s.:			
Caustic soda	4,807	4,491	Do.
Soda ash	567	978	United Kingdom 296; West Germany 285; United States 276.

See footnotes at end of table.

Table 3.—Costa Rica: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	273	477	Guatemala 168; Italy 162; Nicaragua 145.
Worked	47	55	Nicaragua 41; Guatemala 13.
Industrial stone	52	52	Mainly from Nicaragua.
Sand and gravel and crushed rock, n.e.s.	148	644	Mainly from United States.
Other	(3)	(3)	Do.
Sulfur:			
Elemental, all forms	49	160	All from United States.
Sulfur dioxide	1	19	Do.
Sulfuric acid	451	450	Mainly from El Salvador.
Talc, soapstone, pyrophyllite	681	439	Republic of Korea 250; United States 88; Italy 72.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	1,748	1,652	Venezuela 900; Mexico 483.
Coal and coke, including briquets	383	503	West Germany 396; Colombia 80.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	2,948	1,995	All from Venezuela.
Refinery products:			
Gasoline ---do---	435	672	Venezuela 565; Netherlands Antilles 58.
Kerosine ---do---	r 115	91	Trinidad and Tobago 34; Netherlands Antilles 19.
Distillate fuel oil ---do---	673	1,905	Venezuela 1,677; Netherlands Antilles 228.
Lubricants (including grease) ---do---	95	107	El Salvador 33; United States 31; Netherlands Antilles 18.
Other:			
Liquefied petroleum gas ---do---	225	99	Mainly from Panama.
Naphtha ---do---	(3)	(3)	All from United States.
Paraffin ---do---	r 55	17	West Germany 9; Taiwan 3; United States 2.
Petroleum ---do---	8	1	Mainly from United States.
Unspecified ---do---	353	103	Do.
Total ---do---	r 1,959	2,995	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	1,480	2,010	United States 1,569; Netherlands Antilles 437.

r Revised.
1 Metal oxides and hydroxides are excluded because they were reported inseparably from metal salts and other compounds.
2 Excludes an amount valued at $250.
3 Less than ½ unit.

EL SALVADOR

The gold operations of Canadian Javelin Ltd. and Commerce Group Corp. of the United States in eastern El Salvador constituted the principal mining activity of the country. Minas San Cristobal S.A., Javelin's subsidiary, operated the Montecristo mine, where mill capacity was being expanded to 200 tons of ore per day. The company also consolidated several small gold-silver mines. Ore from these operations was being trucked to the Montecristo mill.

Commerce Group's San Sebastián mine, 30 kilometers east of the Montecristo mine at Santa Rosa de Lima, produced about 8,000 tons of ore grading 0.35 troy ounce of gold per ton. A 100-ton-per-day cyanidation plant was operating on the property. Geologists provided Commerce Group with favorable reports on the potential of the area, and the company was seeking partners to help finance its exploration program.

In 1975, El Salvador became the first country in Central America to utilize its geothermal resources; by 1976, the capacity of the Los Ausoles geothermal power station had doubled to 60 megawatts. This

accounted for about 20% of the total power generation capacity of the country. The development of its geothermal resources together with the well-developed hydroelectrical power has enabled El Salvador to become less dependent on fossil fuels to produce electricity.

Table 4.—El Salvador: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975
METALS		
Aluminum metal including alloys, all forms		1,424
Copper metal including alloys, all forms		42
Iron and steel, semimanufactures		10,489
Platinum-group metals including alloys, all forms	troy ounces	1,479
Silver metal including alloys, all forms	do	176,410
Tin metal including alloys, all forms		6,755
Other: Ash and residue containing nonferrous metals		62
NONMETALS		
Abrasives, natural		190
Cement		66
Clays:		
Kaolin		317
Refractory, unspecified		1
Fertilizer materials		28,597
Lime		5
Salt		19,270
Stone:		
Crude and partly worked		45
Worked		52
Sulfur, sulfuric acid		1,895
MINERAL FUELS AND RELATED MATERIALS		
Petroleum refinery products:		
Gasoline and diesel fuel	thousand 42-gallon barrels	22
Lubricants	do	83
Liquefied petroleum gas	do	47
Unspecified	do	110

Table 5.—El Salvador: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity		1975
METALS		
Aluminum metal including alloys:		
Unwrought		648
Semimanufactures		1,614
Copper:		
Copper sulfate		1
Metal including alloys, all forms		1,540
Iron and steel metal:		
Scrap		44
Pig iron, ferroalloys, similar materials		133
Steel, primary forms		27,074
Semimanufactures		37,809
Lead metal including alloys, all forms		250
Nickel metal including alloys, all forms		8
Platinum-group metals	troy ounces	32
Silver metal including alloys, all forms	do	11,863
Tin metal including alloys, all forms		23
Zinc metal including alloys, all forms		498
Other:		
Ores and concentrates		3
Ash and residue containing nonferrous metals		51
Base metals including alloys, all forms		8
NONMETALS		
Abrasives, natural		1,359
Asbestos		3,866
Cement		11,036
Clays and clay products (including all refractory brick):		
Crude:		
Kaolin		4,322
Refractory clay, unspecified		93
Products		2,030
Diamond, industrial	carats	1,125
Diatomite and other infusorial earth		1,295
Feldspar and fluorspar		1
Fertilizer materials, crude and manufactured:		
Nitrogenous		181,145
Phosphatic		48,439
Potassic		8,022
Other, including mixed		22,886
Graphite, natural		4
Gypsum and plasters		8,425
Lime		6,889
Mica, all forms		4
Pigments, mineral, crude		2,399
Salt		55
Sodium compounds, n.e.s.:		
Sodium carbonate		1,258
Sodium hydroxide		6,298
Stone, sand and gravel:		
Dimension stone		3,617
Gravel and crushed rock		930
Sand		682
Sulfur:		
Elemental, all forms		4,520
Sulfuric acid		1,021
Talc, soapstone, pyrophyllite		140
Other		312
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural		53
Coal and coke including briquets		572
Petroleum:		
Crude and partly refined	thousand 42-gallon barrels	3,623
Refinery products:		
Gasoline	do	30
Kerosine	do	12
Lubricants	do	33
Other:		
Liquefied petroleum gas	do	(1)
Mineral jelly and wax	do	13
Bitumen and other residues	do	1
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		52

[1] Less than ½ unit.

GUATEMALA

In 1976, the rate of real growth of the gross national product (GNP) in Guatemala was 10%, significantly higher than the 1% growth of 1975. In February, Guatemala was hit by an earthquake, damaging many villages and taking many lives, but other than manageable infrastructure losses, productive capacity was only lightly affected. The long-term outlook seemed promising in 1976, with the discovery of commercial quantities of petroleum and the commencement of nickel production.

In 1976, Guatemala became the first Central American oil-producing country. Shenandoah Oil Corp. and Basic Resources International S.A. invested about $50 million in exploration and the drilling of four wells at the Rubelsanto structure in the Petén area. The four shallow wells were producing light-gravity oil with flow rates of up to 4,800 barrels per day. The pay zone was thin dolomite in the Cretaceous Coban Formation.

Shenandoah Guatemala Inc. expected that in early 1977 the Guatemalan Government would give it clearance to lay a 120-mile, 12-inch pipeline to connect its Rubelsanto oilfield with an eastcoast tanker terminal.

Production from the large lateritic nickel deposits in northeastern Guatemala was scheduled for the first quarter of 1977. The initial output rate was expected to be about 28 million pounds of nickel per year in the form of 75% nickel matte. The deposits were developed by Exploraciones y Explotaciones Mineras Izabal S.A. (Exmibal). Exmibal, formed in 1960, was owned 80% by International Nickel Co. of Canada Ltd. and 20% by Hanna Mining Co. of the United States.

Minas de Oxec, S.A., a subsidiary of Basic Resources International, operated the Oxec copper mine, west of Lake Izabal. Approximately 300 tons of ore was being milled per day, producing 15,000 tons per year of copper concentrate for sale to Rio Tinto-Patino S.A. Reportedly, nickel and magnesite also occurred within the concession area held by Basic Resources International.

Several areas of lead-zinc-silver-copper mineralization have been prospected near Chiquimula in recent years by Minos de Oriente S.A. (Minorsa), a subsidiary of Lacana Mining Corp., which was formed in Toronto in 1975. If mine development is undertaken, production is expected to be about 10,000 to 15,000 tons of ore per year. Reserves were estimated to be about 1.8 million tons.

HONDURAS

The El Mochito mine of Rosario Resources Corp. was the only operating mine in Honduras during 1976. Mineral exploration during 1976 was restrained as private companies awaited promised changes in the prohibitive tax law passed by the Government in December 1975.

Record tonnages, good grade, and excellent reserves made 1976 one of the best years in overall metal production for the El Mochito mine. The mine produced 321,059 tons of ore and the mill processed 320,812 tons containing 9.68 troy ounces of silver and 0.007 troy ounce of gold per ton, 7.26% lead, and 8.38% zinc.

Production at El Mochito for 1976 is shown in the following tabulation:

	Silver (troy ounces)	Gold (troy ounces)	Lead (metric tons)	Zinc (metric tons)	Cadmium (pounds)
Lead concentrates	2,254,422	1,258	19,326	3,152	--
Zinc concentrates	772,373	582	1,798	21,830	509,000
Dore bullion	156,891	191	--	--	--
Total	3,183,686	2,031	21,124	24,982	509,000

[1] Data may not agree with that given elsewhere because of a difference in source.

Source: Rosario Resources Corp. 1976 Annual Report. P. 5.

A Canadian aid program was underway to assist the Honduran Government in the organization of its mineral development effort and mining legislation. Experts in mining, geology, and claims registry were stationed in Honduras; experts in mapping procedures, tax matters, petroleum geology, coal exploration, and energy policy were to make short advisory trips to the country.

Table 6.—Honduras: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Antimony ore and concentrate, gross weight [1]	255	562	United States 279; Japan 160; Belgium-Luxembourg 123.
Iron and steel metal including alloys, all forms:			
Scrap	9,722	40	Guatemala 15; Mexico 15; United States 10.
Other	1,428	1,139	Guatemala 585; Costa Rica 223; Belize 152.
Lead:			
Ore and concentrate, gross weight [2]	35,655	35,794	Mainly to United States.
Metal including alloys, all forms	--	215	All to Guatemala.
Silver:			
Ore and concentrate, gross weight	[3] 11	--	
Metal including alloys thousand troy ounces	230	132	All to United States.
Zinc:			
Ore and concentrate, gross weight [4]	46,623	52,462	United States 36,061; Japan 9,980; Netherlands 5,250.
Metal including alloys, all forms	--	210	All to Belgium-Luxembourg.
Other: Ash and residue containing nonferrous metals	234	1,002	Mexico 608; Guatemala 211; Netherlands 131.
NONMETALS			
Cement	29,558	101,243	Ecuador 48,152; Nicaragua 14,640; Belize 10,855.
Clays and clay products (including all refractory brick):			
Crude	2	14	All to Nicaragua.
Products	16	67	Guatemala 48; United States 18.
Fertilizer materials, manufactured:			
Nitrogenous	162	--	
Phosphatic	1	--	
Potassic	44	--	
Lime, hydraulic	--	1	All to Guatemala.
Salt	1,634	465	All to Nicaragua.
Sodium and potassium compounds: Soda ash	--	28	All to Guatemala.
Stone, sand and gravel:			
Dimension stone, crude and partly worked	11	31	Mainly to Nicaragua.
Other, including quartz	2	[5]	All to Nicaragua and Guatemala.
Other: Building materials	3,644	1,505	Mainly to Panama.
MINERAL FUELS AND RELATED MATERIALS			
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels	--	4	Mainly to Jamaica.
Kerosine ---do---	--	7	Belize 5; Jamaica 2.
Distillate fuel oil ---do---	--	4	All to Jamaica.
Residual fuel oil ---do---	1,322	1,186	Dominican Republic 600; Panama 338; United States 152.
Lubricants ---42-gallon barrels---	341	231	Belize 121; Paraguay 58; Costa Rica 52.
Other:			
Liquefied petroleum gas ---do---	6,771	4,080	Belize 3,159; Guatemala 650.
Pitch, resin, asphalt, and coke from petroleum ---do---	2,503	1,613	Mainly to Belize.

[1] Antimony content was 223 tons in 1974 and 326 tons in 1975.
[2] Lead content was 22,827 tons and silver content was 2,995,885 troy ounces in 1974; lead content was 28,377 tons and silver content was 1,885,160 troy ounces in 1975.
[3] Silver metal content was 14,075 troy ounces.
[4] Metal content was 18,390 tons of zinc, 638 tons of lead, 113 tons of cadmium, and 711,631 troy ounces of silver in 1974 and 22,254 tons of zinc, 810 tons of lead, 123 tons of cadmium, and 617,166 troy ounces of silver in 1975.
[5] Less than ½ unit.

Table 7.—Honduras: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum metal including alloys, all forms	1,041	845	United States 606; Austria 107.
Copper:			
Copper sulfate	59	68	United States 60; Japan 8.
Metal including alloys, all forms	135	101	Mexico 34; United States 26; Costa Rica 20.
Iron and steel metal including alloys, all forms:			
Scrap	1	(1)	All from United States.
Other	51,067	28,949	Japan 11,171; Belgium-Luxembourg 5,121; United States 4,193.
Lead metal including alloys, all forms	263	231	Panama 87; United States 49; Belgium-Luxembourg 25.
Mercury ——76-pound flasks	3	4	All from United States.
Nickel metal including alloys, all forms	(1)	2	Mainly from Guatemala.
Platinum-group metals, ores and concentrates troy ounces	129	--	
Silver metal including alloys, all forms—do	2,701	581	Mainly from United States.
Tin metal including alloys	9	24	West Germany 11; United States 8; Mexico 5.
Zinc metal including alloys, all forms	454	810	Belgium-Luxembourg 380; Japan 340.
Other:			
Ores and concentrates	1	7	Mainly from Costa Rica.
Ash and residue containing nonferrous metals	(1)	--	
Metals including alloys, all forms	417	71	United States 37; Japan 34.
NONMETALS			
Abrasives, natural, n.e.s	41	28	United States 13; West Germany 7.
Asbestos	2,334	1,892	Italy 1,023; Canada 868.
Cement	1,992	1,601	Japan 575; West Germany 425; Belgium-Luxembourg 296.
Clays and clay products (including all refractory brick):			
Crude kaolin and other clays or earths	1,816	2,979	Guatemala 2,107; United States 865.
Products, including nonclay bricks	1,281	1,941	United States 998; Nicaragua 470.
Diamond, industrial ——kilograms	--	19	All from United States.
Diatomite and other infusorial earth	899	626	Nicaragua 339; United States 205; Mexico 73.
Fertilizer materials:			
Crude, phosphatic	22	25	All from United States.
Manufactured	39,384	30,722	United States 8,865; Netherlands 6,018; West Germany 5,562.
Graphite, natural	2	17	Mainly from France.
Gypsum and plasters	92	28	Mainly from United States.
Lime	715	(1)	All from United States.
Mica, worked	1	(1)	Do.
Pigments, mineral, natural, crude	12	9	Mainly from West Germany.
Precious and semiprecious stones, except diamond ——troy ounces	1,865	289	Switzerland 129; United States 96; Panama 32.
Salt	349	190	United States 150; United Kingdom 38.
Sodium and potassium compounds:			
Caustic soda	1,702	2,564	Nicaragua 1,970; United States 457.
Soda ash	893	351	United States 120; West Germany 101; Guatemala 101.
Caustic potash	85	50	Mainly from United States.
Stone, sand and gravel:			
Dimension stone, all forms	91	115	Mainly from Guatemala.
Sand (including ground quartz)	641	833	Mainly from Panama.
Other stone	427	90	France 70; Guatemala 20.
Sulfur:			
Elemental, all forms	(1)	6	Belgium-Luxembourg 5; United States 1.
Sulfuric and sulfurous acids	450	235	Netherlands 85; United States 78; West Germany 72.
Talc and steatite	100	23	Italy 10; United States 8; United Kingdom 3.

See footnote at end of table.

Table 7.—Honduras: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Other:			
Crude	68	87	West Germany 69; United States 18.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	525	623	Guatemala 460; United States 119.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural	--	(1)	All from United States.
Coal and coke, including briquets	278	150	Guatemala 20; United States 19.
Hydrogen	28	27	United States 27.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	4,303	4,897	All from Venezuela.
Refinery products:			
Gasoline ---do---	71	43	Nicaragua 15; Netherlands Antilles 14; Trinidad and Tobago 8.
Kerosine and jet fuel ---do---	5	3	Nicaragua 1.
Distillate fuel oil ---do---	253	197	Mainly from Venezuela.
Residual fuel oil ---do---	21	1	All from United States.
Lubricants ---do---	52	175	United States 138: Jamaica 28.
Other:			
Liquefied petroleum gas ---do---	1	1	Mainly from Guatemala.
Mineral jelly and wax ---do---	12	4	United States 2; Colombia 1.
Unspecified ---do---	52	73	Nicaragua 37; Netherlands Antilles 34.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	5,632	3,901	United States 2,973; Nicaragua 572.

[1] Less than ½ unit.

NICARAGUA

Mining at one time played an important role in Nicaragua's export sector, but has been declining during the past 20 years. In 1976, only two mining operations were in full production, although exploration continued at a third. Mining accounted for less than 1% of Nicaragua's GDP and employed about 5,000 workers.

Although Nicaragua has a generally favorable tax structure and no history of industrial nationalization, only three large North American companies operated in the country during 1976. American Smelting and Refining Co. (Asarco) and Rosario Resources held 51.8% and 36.2% interest, respectively, in Neptune Mining Company, which operated the Vesubio lead-zinc mine, the second largest lead-zinc mine in Central America after the El Mochito mine in Honduras. The startup of the Vesubio mine in the early 1970's assured continuation of mining in a district that has been confronted with rising production costs and declining gold ore reserves.

Neptune's mill treated 165,681 tons of sulfide ore averaging 0.10 troy ounce of gold and 0.6 troy ounce of silver per ton, 0.8% lead, 0.5% copper, and 9.1% zinc; and 34,749 tons of gold ore averaging 0.21 troy ounce of gold per ton. Assured and probable sulfide reserves at yearend 1976 were estimated to be 1,049,554 tons of ore grading 8.61% zinc, 1.15% lead, 0.46% copper, and 0.11 troy ounce of gold and 0.96 troy ounce of silver per ton. Gold ore reserves were increased by 32,336 tons to 87,681 tons with a grade of 0.32 troy ounce per ton.

Noranda Mines Ltd. of Canada held a 60.5% interest in Empresa Minera de el Setentrion, the most important gold producer in Central America. In 1976, production totaled 111,584 tons of ore averaging 0.44 troy ounce of gold per ton. The Panteon vein was the main source of the ore. At yearend 1976, proved reserves totaled 160,572 tons of ore grading 0.5 troy ounce of gold per ton.

Exploration for petroleum by Union Oil Co. and Chevron Oil Co., both of the United States, resulted in no significant discoveries. Nicaragua's only refinery was

owned and operated by Esso Standard Oil S.A. Ltd., a wholly owned subsidiary of Exxon Corp. The installed capacity of the refinery was 21,000 barrels per day. The crude oil was imported from Venezuela.

Table 8.—Nicaragua: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum metal including alloys, all forms	36	95	Honduras 40; El Salvador 39; Costa Rica 16.
Copper:			
Ore and concentrate	6,862	3,310	West Germany 2,507; United States 803.
Metal including alloys, all forms	(1)	2	Mainly to United States.
Iron and steel metal:			
Scrap	1,087	12	Mainly to West Germany.
Semimanufactures	r 3,348	7,729	El Salvador 2,876; Honduras 2,113; Guatemala 1,659.
Lead:			
Ore and concentrate	8,459	5,548	All to United States.
Metal including alloys, all forms	13	--	
Silver metal, worked and partly worked troy ounces	197,759	142,462	Canada 125,774; United States 16,686.
Zinc:			
Ore and concentrate	33,579	15,571	United States 10,190; Spain 5,380.
Metal including alloys, all forms	115	39	Honduras 20; United States 19.
Other: Scrap and waste of nonferrous metals	988	382	Belgium-Luxembourg 173; West Germany 107.
NONMETALS			
Abrasives, natural	--	(1)	All to Costa Rica.
Cement	2,261	--	
Clays and clay products:			
Crude	20	52	Costa Rica 45; El Salvador 7.
Products:			
Refractory (including nonclay bricks)	20	3	All to Costa Rica.
Nonrefractory	r 3,414	2,814	Costa Rica 1,929; Honduras 453.
Diatomite	565	771	El Salvador 354; Honduras 349.
Feldspar and related materials	16	222	All to Costa Rica.
Fertilizer materials:			
Crude, nitrogenous	5	--	
Manufactured:			
Nitrogenous	r (1)	318	Mainly to Honduras.
Phosphatic	70	5	All to Honduras.
Other, including mixed	1	221	Do.
Gypsum and plasters	13,814	16,279	All to Costa Rica.
Lime	731	737	Mainly to Costa Rica.
Salt	8,058	7,133	Do.
Sodium and potassium compounds, caustic soda	22,533	19,953	Guatemala 7,176; El Salvador 6,153; Costa Rica 4,649.
Stone, sand and gravel:			
Dimension stone, crude and partly worked	191	218	All to Costa Rica.
Other stone, industrial	46	62	Mainly to Guatemala.
Sand, including ground quartz	--	46	Mainly to Costa Rica.
Talc and steatite, natural	--	7	Mainly to Honduras.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural	35	40	All to Costa Rica.
Hydrogen, helium, rare gases	8	(1)	All to El Salvador.
Petroleum refinery products:			
Gasoline, 42-gallon barrels	r 621	--	
Kerosine, do.	r 3,985	9,308	Mainly to Costa Rica.
Distillate fuel oil, do.	r 1,180	--	
Lubricants, do.	3	76	Costa Rica 40; United States 36.
Other:			
Liquefied petroleum gas, do.	25,105	7,030	All to Costa Rica.
Pitch, resin, petroleum asphalt, petroleum coke, and other byproducts of coal and petroleum, do.	110,431	106,264	Mainly to Costa Rica.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	3,086	1,772	Costa Rica 814; Guatemala 370; El Salvador 362.

r Revised.
1 Less than ½ unit.

Table 9.—Nicaragua: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum metal including alloys, all forms	r 1,570	1,360	United States 415; El Salvador 319; Canada 204.
Copper:			
Ore and concentrate	(1)	--	
Copper sulfate	124	16	United States 9; West Germany 4.
Metal including alloys, all forms	154	149	West Germany 51; Mexico 36; United States 36.
Iron and steel metal:			
Scrap	4	6	Mainly from Costa Rica.
Ferroalloys	--	40	All from Mexico.
Primary forms	r 17,452	10,544	Belgium-Luxembourg 5,045; West Germany 3,506; France 1,960.
Semimanufactures	r 117,094	40,451	Japan 20,286; United States 4,782; El Salvador 3,943.
Lead metal including alloys, all forms	207	170	Mexico 72; Denmark 62.
Nickel metal including alloys, all forms	1	(1)	Mainly from West Germany.
Silver metal, worked and partly worked troy ounces	9,645	5,980	Mainly from United States.
Tin metal including alloys, all forms	29	17	United Kingdom 10; United States 4.
Zinc metal including alloys, all forms	1,220	301	Belgium-Luxembourg 140; Panama 76; Japan 75.
Other:			
Ores and concentrates of base metals, n.e.s	(1)	(1)	All from United States.
Scrap of nonferrous metals	14	2	Mainly from Costa Rica.
Base metals including alloys, all forms, n.e.s	13	11	All from United States.
NONMETALS			
Abrasives, natural, including industrial diamond	337	274	Costa Rica 120; Belgium-Luxembourg 82; United States 27.
Asbestos	1,170	1,207	Canada 722; United States 381; U.S.S.R. 100.
Boric acid	6	8	West Germany 5; Netherlands 1.
Cement	4,523	5,766	Costa Rica 2,760; Japan 1,192; United States 704.
Clays and clay products:			
Crude	6,241	3,411	United States 2,534; United Kingdom 612.
Products:			
Refractory	999	773	United States 554; Mexico 126; Costa Rica 80.
Nonrefractory	573	688	Italy 226; Spain 170; Japan 88.
Diatomite	1,841	750	United States 451; Mexico 299.
Feldspar and related materials	1,091	675	Mainly from Guatemala.
Fertilizer materials:			
Crude	20	1	Mainly from West Germany.
Manufactured:			
Nitrogenous	94,451	59,299	United States 16,876; Romania 11,585; Netherlands 9,710.
Phosphatic	29,528	7,577	Mainly from Costa Rica.
Potassic	5,556	753	Costa Rica 437; Honduras 178; United States 138.
Other, including mixed	12,531	253	United States 146; Costa Rica 53; West Germany 50.
Graphite, natural	4	6	United States 3; Mexico 2; West Germany 1.
Gypsum and plasters	315	284	Mainly from United Kingdom.
Lime	2,580	1,927	United Kingdom 1,463; West Germany 455.
Mica, worked, including splittings and waste	r 1	2	West Germany 1; United States 1.
Pigments, mineral, natural	(1)	23	Costa Rica 20; United States 3.
Precious and semiprecious stones, including diamond kilograms	2	5	West Germany 2; Switzerland 1; Taiwan 1.
Salt	32,194	26,464	Mainly from Chile.
Sodium and potassium compounds, n.e.s	803	3,719	Mainly from United States.
Stone, sand and gravel	r 1,299	385	Costa Rica 243; Guatemala 71.

See footnotes at end of table.

Table 9.—Nicaragua: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Sulfur:			
Elemental	328	230	West Germany 129; Belgium-Luxembourg 100.
Sulfuric acid	727	697	Mainly from El Salvador.
Talc	499	179	United States 123; Taiwan 53.
Other crude nonmetallic minerals	3,120	1,179	United States 861; Belize 318.
MINERAL FUELS AND RELATED MATERIALS			
Carbon black	5	2	All from West Germany.
Coal, coke, peat	6	8	All from United States.
Hydrogen, helium, rare gases	r 1	--	
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	r 4,292	4,292	Mainly from Venezuela.
Refinery products:			
Gasoline ---do---	r 107	97	Netherlands Antilles 76; Panama 14.
Kerosine ---do---	r 22	17	Netherlands Antilles 11; Panama 4.
Distillate fuel oil ---do---	r 233	232	Panama 162; Trinidad and Tobago 27.
Lubricants ---do---	61	56	United States 25; Jamaica 12; El Salvador 9.
Other:			
Liquefied petroleum gas ---do---	(1)	(1)	Mainly from United States.
Mineral jelly and wax ---do---	19	5	Japan 3; United States 1.
Pitch, resin, petroleum asphalt, petroleum coke, and other coal and petroleum residues ---do---	1	1	Mainly from United States.
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	4,655	4,465	Netherlands Antilles 2,043; United States 2,024.

r Revised.
1 Less than ½ unit.

PANAMA

For the second consecutive year, the economy of Panama had a real growth rate of about 2%. Economic policy-making was a major concern during 1976, with the national development plan for 1976–80 being made public. One of its objectives involved an ambitious public-sector investment program for both specific projects (copper, cement, and hydroelectrical power) and general infrastructure development.

In February, the Panamanian Legislative Council approved the two proposed contracts between Cerro Colorado Development Corp. and Texasgulf Inc. for exploitation of the Cerro Colorado copper deposit. An adit, started in April, was driven 460 meters into the deposit. Bulk samples from the adit were being used for pilotplant test work and for comparison with diamond drill core assays. About 35 additional diamond drillholes were completed to provide further information on grade, geology, structure, rock strength, and overburden. More than 150 holes had previously been drilled into the deposit. The final geologic report was scheduled to be completed by October 1977. Brown & Root, Inc., of the United States and Seltrust Engineering Ltd. of the United Kingdom were providing engineering services for the concentrator, roads, port, smelter, and related facilities. Additional studies on marketing, financing, training, and the environment were progressing.

Panama's only refinery, Refineria Panama S.A., a subsidiary of Texaco Inc., operated at 70% capacity during 1976, processing about 80,000 barrels of oil per day. The crude oil, imported from Ecuador, Venezuela, Saudi Arabia, and Nigeria, represented about one-fourth of Panama's total imports of $784 million in 1976. Of the crude oil imported, 37% was used directly for light products, mainly gasoline. The residues and heavy products were exported or sold to ships passing through the Panama Canal.

Northville Industries Corp. of the United States and the Panamanian Government were negotiating for the formation of a company to build and operate a large crude oil transshipment terminal at Puerto Armuelles on the Pacific coast. The terminal was to be designed for offloading tankers too large to pass through the Panama Canal. The oil is to be transferred to storage tanks and then to smaller tankers for transport through the Canal and ultimate delivery to the refineries on the U.S. gulf coast and east coast. Completion of the terminal was scheduled for 1978.

A geothermal energy program was being jointly conducted by the Government agency Instituto de Recursos Hidraulicos y Electrificacion and the Government/Texasgulf copper enterprise, Cerro Mining Development Corp. Concentrated efforts were centered in the Chiriquí and Veraguas Provinces, which had been determined as the most potentially profitable sources of geothermal energy.

The Mineral Industry of Other Areas of the Far East and South Asia

By Staff, International Data and Analysis

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BANGLADESH [1]

Following a year of great uncertainty, the political situation in Bangladesh improved during 1976. The major problem for Bangladesh remained the high birth rate and crowded conditions. Bangladesh had the highest population density of any agrarian country—over 80 million people in a land area of 144,000 square kilometers, 65% of which is considered arable.

The Government, with considerable foreign assistance, was actively encouraging voluntary family planning, and set a growth rate target of 2% per year or less. However, even if the growth rate was reduced to the target level immediately, the population of Bangladesh would nevertheless nearly double within 20 years.

Bangladesh enjoyed 2 consecutive years of excellent harvests which helped to stabilize prices. While the increased food production lowered import levels, the goal of food self-sufficiency was not reached. Moreover, food production increases did not keep up with the population growth, and grains and other staples will continue to be imported for some time.

The gross domestic product (GDP) stood at $4.87 billion [2] in fiscal 1976,[3] showing an encouraging 11% increase in real terms over that of fiscal 1975. The cost-of-living index (fiscal 1970=100) dropped to 380 in fiscal 1976 from 408 in fiscal 1975. The wholesale price index dropped from 454 to 338 during the same period.[4]

The Government began to return businesses taken over in 1972 to private ownership, reserving only the three major industries—jute, textiles, and sugar—for Government ownership. The Government was endeavoring to promote private and foreign investment in an effort to increase industrial output. Industry presently accounts for 10% of the GDP, and most activities are related to the processing and manufacture of jute products.

As a result of a stringent fiscal stabilization program, the high inflation rate of recent years was curbed, strict credit ceilings were imposed, and the budget was held nearly in balance in fiscal 1976. The trade deficit, however, continued to be a

[1] Prepared by Gordon L. Kinney, physical scientist.
[2] Where necessary, values have been converted from Bangladesh takas to U.S. dollars at the rate of 15.5 takas=US$1.00.
[3] The Bangladesh fiscal year is the year ending June 30 of that stated.
[4] U.S. Embassy, Dacca, Bangladesh. State Department Airgram A-27, Feb. 18, 1977, pp. 1-10.

burden to Bangladesh, although it fell from $1 billion in fiscal 1975 to around $884 million in fiscal 1976. The deficit was financed by grants and loans from many foreign countries and international financial institutions. Export earnings increased 6% to about $380 million in fiscal 1976. Minerals played virtually no part in export revenue; raw jute and jute products accounted for over 80% of total exports. Imports dropped 10% to $1.27 billion in fiscal 1976. The dominant imports were foodstuffs and petroleum.

The search for oil and gas in Bangladesh continued throughout 1976 with mixed results. Six foreign companies were operating at the beginning of the year: Union Oil Co. of California, Atlantic Richfield Company, and Ashland Oil (Bangladesh) Co. of the United States; Superior Oil Company of Canada; Bengal Oil Development Corp. of Japan; and INA-Naphthalin of Yugoslavia. During fiscal 1976, these firms in addition to Toila Sandhanee Co. (TSC), the operational subsidiary of the Government-owned Petrobangla Oil Co., conducted surveys and drilled at seven onshore and offshore locations. TSC's onshore drilling was at Begumganj in Noakhali District and Hijia-Muladi in Barisal District. Both wells showed positive signs of natural gas. Further testing was to be conducted to determine the potential of the structures.

Offshore, INA-Naphthalin drilled one hole to 13,400 feet in its concession early in the drilling season but ran into unusually high pressures after hitting gas and was forced to seal and abandon the well. In December, the company joined with Texas Pacific Oil Co., Inc. (a 20% partner) to test the formation again. The drilling was scheduled for completion in late February 1977. Bengal Oil capped its first hole in March, and a second well was abandoned in June after hitting noncommercial gas at 14,500 feet. Union was forced to stop drilling at its first site because of unstable bottom conditions. Union contracted for a new rig and operations were scheduled to resume after the monsoon ended, probably in November at the earliest. Atlantic Richfield began drilling its first well in January and abandoned it as dry in April.[5]

In an effort to encourage and expedite the pace of oil exploration, Petrobangla called for bids in July on newly opened concession areas covering over 105,000 square kilometers onshore and 8,300 square kilometers offshore. Both areas were to be contracted under production-sharing agreements. In addition, the Government announced that it would consider joint-venture arrangements within its own reserve area of 26,000 square kilometers around Dacca.

Natural gas production increased modestly during 1976 to around 1 billion cubic meters. Development of the seven proven gasfields continued, with four presently being exploited on a commercial scale—Titas, Habiganj, Sylhet, and Chhatak. Development work was underway at the Titas Field to increase production to 4.25 million cubic meters per day (150 million cubic feet per day) by mid-1977. The distribution network from the Titas Field was to be expanded to the greater Dacca area and several nearby cities by eventually laying 1,400 additional kilometers of gas distribution pipeline. Initial work on the project was begun in 1976 with funds from a loan from the Asian Development Bank. Work began on a pipeline to supply the large tea plantations of the Laskerpore Valley with about 28,000 cubic meters per day (1 million cubic feet per day) of gas from the nearby Habiganj Field.

The Government planned to establish an integrated ammonia-urea fertilizer plant at Chittagong. Planned capacity was 1,000 tons per day of ammonia and 1,730 tons per day of urea. The plant would draw gas through a 200-kilometer pipeline from the field being developed at Bakrabad in Barisal District. The pipeline would have the capacity to service other industries in the Chittagong area as well. The Chittagong area consumes about $48 million worth of imported petroleum fuels per year.

The 1.5-million-barrel-per-day Eastern Refinery Ltd. at Chittagong, the country's only refinery, operated satisfactorily during the year after a complete overhaul in late 1975. The plant had operated well below capacity in the past few years. The 1976 output was estimated at 1.2 million tons, all from imported crude oil. The imported crude oil, costing about $175 million in 1976, included 600,000 tons from the

[5] U.S. Embassy, Dacca, Bangladesh. State Department Airgram A-85, Aug. 6, 1976, pp. 1-7.

United Arab Emirates, 400,000 tons from Iran, and 200,000 tons from Saudi Arabia.[6]

Aside from natural gas production, the mineral industry contributed very little to the overall economy of Bangladesh. In 1976, cement production more than doubled the prior year's output to 219,000 tons, and nitrogenous fertilizer output quadrupled. However, salt production declined 25%.

Plans were made for the development of a limestone mine and construction of a 1-million-ton-per-year cement plant at Jaipurhat in Bogra District. The project was estimated to cost about $200 million and was to get underway when suitable financing could be arranged.

The Bangladesh Atomic Energy Commission began exploring for uranium and thorium in December 1976 in the sedimentary rocks of Sylhet District and the placer sands of Chittagong District.

[6] U.S. Embassy, Dacca, Bangladesh. State Department Telegram 0021 R 031001, Jan. 18, 1977, pp. 1–3.

Table 1.—Other Areas of the Far East and South Asia: Production of mineral commodities

Area,[1] commodity, and unit of measure	1974	1975	1976 p
BANGLADESH [2]			
Cement, hydraulic ---- thousand metric tons	85	93	219
Clays (china clay) ---- metric tons	1,200	3,384	1,575
Fertilizer materials, manufactured: [3]			
Gross weight [e] ---- thousand metric tons	280	71	282
N content ---- do	130	33	131
Gas, natural, marketed [4] ---- million cubic feet	17,223	33,000	35,000
Iron and steel:			
Crude steel ---- thousand metric tons	81	--	82
Mild steel products ---- do	140	--	80
Petroleum refinery products:			
Gasoline ---- thousand 42-gallon barrels	369	373	468
Jet fuel ---- do	105	124	166
Kerosine ---- do	782	1,258	1,985
Distillate fuel oil ---- do	522	895	1,306
Residual fuel oil ---- do	1,424	2,026	3,000
Other:			
Naphtha ---- do	81	429	831
Unspecified ---- do	269	208	216
Refinery fuel and losses ---- do	281	459	458
Total ---- do	3,833	5,772	8,430
Salt, marine ---- thousand metric tons	169	746	560
Stone, limestone, industrial ---- do	81	70	61
BRUNEI [2]			
Gas, natural:			
Gross production ---- million cubic feet	243,811	268,390	341,343
Marketed ---- do	176,820	186,531	263,501
Natural gas liquids:			
Condensate ---- thousand 42-gallon barrels	2,083	2,566	4,031
Natural gasoline ---- do	431	397	573
Liquefied petroleum gas ---- do	186	143	144
Total ---- do	2,700	3,106	4,748
Petroleum:			
Crude ---- do	70,338	65,932	74,424
Refinery products:			
Gasoline ---- do	119	160	153
Distillate fuel oil ---- do	238	221	209
Residual fuel oil ---- do	1	1	1
Other ---- do	46	40	32
Refinery fuel and losses ---- do	—1	1	1
Total ---- do	403	423	396
CAMBODIA [e 2]			
Cement, hydraulic ---- thousand metric tons	50	50	50
Gold, mine output, metal content ---- troy ounces	4,000	500	1,000
Salt ---- metric tons	30,000	30,000	30,000
HONG KONG [2]			
Cement, hydraulic ---- thousand metric tons	571	575	767
Clays, kaolin ---- metric tons	3,320	1,490	1,305
Feldspar ---- do	5,566	2,059	2,299
Iron ore and concentrate, gross weight ---- do	159,737	167,200	37,058
Quartz ---- do	351	761	982

See footnotes at end of table.

Table 1.—Other Areas of the Far East and South Asia: Production of mineral commodities—Continued

Area,[1] commodity, and unit of measure	1974	1975	1976 p
LAOS			
Salt, rock ---------- metric tons	9,600	e 10,000	e 10,000
Tin, mine output, metal content ---------- do	r 594	518	e 576
MONGOLIA [2]			
Cement, hydraulic ---------- thousand metric tons	171	159	e 160
Coal:			
Anthracite and bituminous ---------- do	137	137	e 200
Lignite and brown ---------- do	2,337	2,549	e 2,650
Total ---------- do	2,474	2,686	e 2,850
Fluorspar, all grades e ---------- metric tons	250,000	302,000	302,000
Gypsum e ---------- do	25,000	25,000	25,000
Lime, hydrated, and quicklime e ---------- do	40,000	40,000	40,000
Petroleum refinery products: e			
Kerosine ---------- thousand 42-gallon barrels	16	23	NA
Residual fuel oil ---------- do	13	20	NA
Total of listed figures ---------- do	29	43	NA
Salt ---------- metric tons	11,000	11,000	11,000
SINGAPORE [2]			
Cement, hydraulic ---------- thousand metric tons	1,050	r e 1,320	e 1,350
Iron and steel: Crude steel e ---------- do	r 220	r 220	230
Petroleum refinery products:			
Gasoline ---------- thousand 42-gallon barrels	28,299	18,111	11,985
Jet fuel ---------- do	21,525	19,460	24,022
Kerosine ---------- do	4,583	5,587	10,244
Distillate fuel oil ---------- do	32,280	37,112	43,479
Residual fuel oil ---------- do	53,665	39,956	52,341
Lubricants ---------- do	1,642	2,118	3,001
Other ---------- do	8,261	11,683	21,896
Refinery fuel and losses ---------- do	6,433	5,048	5,635
Total ---------- do	156,688	139,075	172,603
Stone, granite, broken ---------- thousand cubic meters	1,795	2,302	2,524
Sulfur, byproduct from oil refining e ---------- metric tons	6,000	6,000	7,000
SRI LANKA			
Cement, hydraulic ---------- thousand metric tons	474	393	426
Clays:			
Ball clay ---------- metric tons	NA	1,423	796
Kaolin ---------- do	5,888	2,682	4,360
Other [5] ---------- do	NA	60,090	59,339
Coke, gashouse ---------- thousand metric tons	e 7	e 7	NA
Feldspar, crude and ground ---------- metric tons	779	1,270	3,199
Gem stones, precious and semiprecious, except diamond value, thousands	$23,822	$19,965	$39,389
Graphite, all grades ---------- metric tons	10,427	11,982	8,290
Mica, scrap ---------- do	180	26	37
Petroleum refinery products:			
Gasoline ---------- thousand 42-gallon barrels	829	746	846
Jet fuel ---------- do	454	439	615
Kerosine ---------- do	1,572	1,610	1,460
Distillate fuel oil ---------- do	2,670	2,702	2,719
Residual fuel oil ---------- do	3,964	3,580	3,421
Other ---------- do	1,059	1,068	1,095
Refinery fuel and losses ---------- do	709	746	664
Total ---------- do	11,257	10,891	10,820
Rare-earth minerals: Monazite concentrate, gross weight metric tons	6	7	1
Salt ---------- do	120,000	121,000	140,504
Sand and gravel, glass sand ---------- do	43	NA	NA
Stone:			
Dolomite ---------- do	NA	3,136	NA
Limestone ---------- thousand metric tons	784	714	647
Quartz, massive ---------- metric tons	305	296	838
Titanium:			
Ilmenite concentrate, gross weight ---------- do	81,098	64,010	55,814
Rutile concentrate, gross weight ---------- do	3,051	3,111	1,039
Zirconium concentrate, zircon, gross weight ---------- do	21	39	10
VIETNAM e [6]			
Cement, hydraulic ---------- thousand metric tons	700	700	730
Chromite ---------- do	NA	NA	35
Clay, kaolin ---------- metric tons	1,000	1,000	1,000
Coal, anthracite ---------- thousand metric tons	3,500	4,000	5,000

See footnotes at end of table.

Table 1.—Other Areas of the Far East and South Asia: Production of mineral commodities—Continued

Area,[1] commodity, and unit of measure	1974	1975	1976 [p]
VIETNAM [e 6]—Continued			
Fertilizer materials, crude: Phosphate rock thousand metric tons	1,200	1,400	1,500
Gypsum metric tons	7,000	7,000	7,000
Iron and steel:			
Primary, ingot do	200	200	200
Semimanufactures, rolled do	20	20	20
Salt thousand metric tons	350	[r] 200	63
Tin:			
Mine output metric tons	250	250	250
Smelter output [7] do	200	200	200
Zinc, mine output, metal content do	5,000	10,000	10,000

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the countries listed, Nepal, covered textually in this chapter, presumably produces a variety of crude construction materials such as clays, stone, sand and gravel, and possibly cement, but production statistics are not available and general information is inadequate to make reliable estimates of output levels.

[2] In addition to the commodities listed, a variety of crude construction materials such as clays, stone, and sand and gravel presumably were produced, but production statistics are not available and general information is inadequate to make reliable estimates of output levels.

[3] For years ending June 30 of that stated.

[4] Gross production is not reported; marketed output is reported in lieu of estimating gross output because the quantity vented, flared, or reinjected is believed to be small.

[5] For cement production only.

[6] In addition to the commodities listed, iron ore and lead-zinc ores were mined in the past and the country produced pig iron, crude steel, and smelter zinc at its industrial facilities, but the status of these industries under prevailing conditions is not sufficiently clear to permit preparation of reliable estimates of output levels. Similarly, no data on output of crude construction materials are available and no reliable basis for estimation is available.

[7] Based on import statistics of the U.S.S.R. and Japan.

BRUNEI [7]

Oil and natural gas were the only significant minerals produced in Brunei in 1976, and the value of export shipments of these fuels accounted for a very favorable monetary return for this small country of less than 200,000 population. Total revenues of the Brunei Government were $520 million [8] in 1975 and were expected to reach $670 million in 1976. Government earnings were derived mainly from taxes, royalties, and dividends from oil and natural gas production. A minor amount was derived from the sale of natural rubber and timber. In 1976, recurring Government expenditures were estimated at $207 million and additional expenditures for development projects were estimated at $57 million. Thus, the Government stood to have a surplus of around $400 million for 1976. The total consolidated revenue fund surplus, accumulated mostly during the past decade, was more than $1,250 million.

The Government assumed 50% ownership of Brunei Shell Petroleum Co. Ltd. (BSP) after revision of the sultanate's Petroleum Mining Act in 1975. Moreover, the Government was reportedly negotiating an increase of its 10% interest in Brunei Liquefied Natural Gas Co. (BLNG) and was attempting to attain equity in the Shell-Mitsubishi-owned marketing company.

Although no figures were available, the 1974–75 inflation rate of 12% was believed to have been reduced substantially in 1976 by new Government price control measures.

Plans for diversifying the Brunei economy did not progress significantly during the year. No decision was reported by yearend on the establishment of an oil palm plantation that had been proposed as an alternative to setting up a large pulp and paper mill at Kuala Belait. While both projects could be undertaken, this would involve committing all available land in the Ulu Belait area, much of which is now a forest reserve. A feasibility study on a Government-approved fertilizer plant was completed during 1976, but by yearend no decision was reported to start construction.

BSP, operating under the new 50/50 ownership with the Government, produced

[7] Prepared by Gordon L. Kinney.

[8] Unless otherwise specified, values have been converted from Brunei dollars (B$) to U.S. dollars at the rate of B$2.48=US$1.00 in 1975 and B$2.39=US$1.00 in 1976.

over 200,000 barrels per day of crude oil during 1976. Production was from one onshore oilfield (Seria) and four offshore fields. Production from the Champion Shoals Field increased around 90% to 46,000 barrels per day in 1976. The large increase was attributed to the completion of repairs on an offshore platform damaged by a well blowout in late 1974. Fairley Field production increased about 25%. Output from Champion Shoals and Fairley accounted for most of the 13% overall increase in crude oil production during the year. Total crude oil production in 1976 was 74 million barrels valued at $965 million, nearly 23% higher than the 1975 value. Crude oil reserves were estimated at 1.83 billion barrels at yearend 1976.

Seismic surveying activity increased during the year, with a total of 15 crew-months compared with 4 crew-months in 1975. Twenty-six offshore development wells struck oil and four struck gas in the Southwest Ampa, Fairley, and Champion Shoals Fields. In addition, there were five successful oil wildcat wells and two gas discoveries.

Gross production of natural gas increased 27% in 1976. Marketed gas output totaled 7.46 billion cubic meters, an increase of 41% over that of 1975. The value of production of natural gas liquids nearly doubled to $60 million.

All of the marketed natural gas was processed at the BLNG plant at Lumut. Shipments of liquefied natural gas (LNG), all to Japan, totaled 4,836,000 tons in 1976, valued at $468 million.[9] Natural gas reserves were estimated at 177 billion cubic meters at yearend 1976.

The 5-million-ton-per-year BLNG plant operated at nearly design capacity during 1976. All five liquefaction lines operated satisfactorily throughout the year. The plant had had technical and break-in problems since the first line began operating in 1973. There were compressor and turbine malfunctions, and in addition, fouling of the cooling water system caused serious heat transfer problems. Repairs and modifications were made and design improvements were incorporated into units installed later. As a result, overall plant efficiency was improved considerably, downtime was reduced, and the energy required to produce 1 ton of LNG was reduced about 20%. The Lumut plant was the first LNG facility in the Asia-Pacific area and the largest operating plant in the world at yearend.

CAMBODIA (KAMPUCHEA)[10]

With the fall of the Lon Nol Government on April 17, 1975, a regime headed by Khieu Samphan was installed, and a political, economic, and social reorganization of the country began. On January 5, 1976, a new constitution was adopted and the country was officially renamed Democratic Kampuchea. The constitution provided for the election of a 250-man representative assembly every 5 years, with the assembly electing an administration to implement the laws and political policy laid down by it. Also, a three-man State presidium headed by the President was to represent the country in foreign affairs. General elections were held on March 20, 1976, and the representatives to the new assembly were announced 24 hours later. Subsequently, Khieu Samphan was officially made head of state and Pol Pot was named prime minister.

No meaningful statistical data were available on Cambodia's visible trade during 1976. Presumably, the People's Republic of China and other countries provided credit and financial assistance through shipments of iron and steel products, heavy equipment and machinery, and replacement parts, as well as technical assistance to rebuild and restore Cambodia's small and limited manufacturing industries. Assistance in the form of medical supplies, foodstuffs, fertilizers, and agricultural materials was probably also provided to help solve the country's health and nutrition problems.

No official data on mineral production were issued by the Cambodian Government during the year. However, the value of mineral production probably contributed very little to the overall economy of the predominantly agrarian country. The only significant operation is the mining of phosphate rock which is ground and processed for use as a fertilizer. Phosphate rock was

[9] Value was converted from Japanese yen (Y) to U.S. dollars at the rate of Y296.55=US$1.00.
[10] Prepared by Gordon L. Kinney.

reportedly mined at Tuk Méas (10°40′ N, 104°34′ E) in Kampot Province, and Môngkól Borei (13°28′ N, 103°10′ E) and Phnom Sampou (13°02′ N, 103°06′ E) in Battambang Province. A plant to grind the ore was located at Tuk Méas, with a design capacity of 12,000 tons of P_2O_5 content per year. The plant, which had been out of operation since 1970, was operating during 1976 at a very small fraction of its former output.

Cambodia also produces gold, gem stones, salt, nonmetallic construction materials, and cement. In December 1976, a cement plant at Châkrei Ting (10°42′ N, 104°16′ E) near Kampot was reportedly reopened.

Other mineral occurrences in the country include bauxite, coal, copper, iron, lead, manganese, and silver. Transportation problems and lack of investment funds prevented the development of commercial deposits of bauxite beyond the planning stage. In the north, there is high-grade iron ore, but reported reserves of only 2.5 million tons and very limited transport facilities presently preclude the economic development of the deposits.

There was no domestic production of crude oil or natural gas, and the old 12,000-barrel-per-day petroleum refinery at Kompong Som has probably not been reactivated. The plant was damaged during the civil war and the equipment was mothballed. Reopening of the plant would require a considerable financial outlay and foreign technical assistance.

No petroleum exploration was reported by the Cambodian Government during the year. Exploration by foreign companies in the country was probably not permitted, and the offshore concessions granted by the former government to French and Canadian companies remained inactive since 1975.

HONG KONG [11]

Hong Kong's GDP in 1976 was estimated at $8.8 billion [12] at current market prices compared with $7.2 billion in 1975. In terms of constant 1966 prices, the GDP in 1976 was $4.8 billion, a real growth of about 15% over that of 1975. The British crown colony relied almost wholly on foreign raw materials to meet the needs of its population and industries. Light manufacturing dominated the local economy, and aside from tourism, business conditions in Hong Kong were dependent on sales and shipments of export goods. Production of textiles and clothing, electronic articles, plastic products, watches and clocks, and other consumer accessories, in that order, accounted for over 80% of the value of the colony's total domestic export.

Total trade during 1976 was $17.3 billion, up $4.4 billion from that of 1975. During the year, domestic exports were valued at $6.7 billion and reexports at $1.8 billion. Exports of manufactured goods and articles constituted 82% of the total value of exports, machinery and transport equipment 15%, food 2%, and other 1%. Principal export destinations were the United States, West Germany, the United Kingdom, Japan, Canada, Australia, and others, in that order. Total imports in 1976 were valued at $8.8 billion, comprising the following, in billion dollars: Manufactured goods and articles, 3.8; machinery and transport equipment, 1.6; food, 1.4; and other, 2.0. Imports of petroleum and petroleum products in 1976 were valued at $528 million. Sources of Hong Kong's imports were as follows, in percent: Japan, 21.6; the People's Republic of China, 17.9; the United States, 12.3; Taiwan, 7.1; Singapore, 5.8; and other, 35.3.

The total value of mine output of minerals excluding aggregates and cement was $764,915 in 1976. Production of 50% iron ore concentrate was 37,058 tons, constituting about 76% of the total mineral output value. The iron ore was mined at Ma On Shan in the New Territories, and the magnetite concentrate was shipped to Japan. Owing to the lower tenor of the ore body and economic considerations, the mine ceased operation in April 1977. Output of quartz and feldspar was higher in 1976 than in the previous year, while clay and kaolin production decreased 12%. About 70% of the kaolin was exported to Japan and most of the feldspar to Taiwan. All of

[11] Prepared by E. Chin, physical scientist.

[12] Where necessary, values have been converted from Hong Kong dollars (HK$) to U.S. dollars at the rate of HK$4.905=US$1.00.

the quartz output, as well as some of the feldspar and kaolin, was consumed locally.

At yearend 1976, there were eight quarries operating in Hong Kong, two of which were Government run. The Cha Kwo Ling quarry, the largest unit, had a capacity of over 1.5 million tons per year, followed by the Shek O quarry with 1.0 million tons per year. The dominant rock type is granite. Annual consumption of rock aggregate was estimated to be between 7 million and 8 million tons, and that of marine sand dredged from the sea bed, 1 million tons. Local output supplies about 25% of the total demand.

Green Island Cement Co. operated a 790,000-ton-per-year cement plant at Hung Hom, Kowloon. The company imports cement clinker and grinds the clinker to produce finished cement for the local construction industry. Green Island announced plans to relocate its cement plant and expand its annual capacity.

During 1976, the People's Republic of China supplied Hong Kong with about 300,000 tons of refined oil products, compared with about 250,000 tons in 1975. Fuel oil dominated the deliveries, but gas, diesel fuel, aviation turbine fuel, kerosine, and lubricants were also included. Imports from the People's Republic of China accounted for about 7% of Hong Kong's total oil needs. The colony is dependent on imported fuel, particularly refined oil, for its energy requirements. However, Shell Oil Co. proposed the construction of a 200,000-barrel-per-day refinery on Lamora Island.

Under the mining ordinance, the ownership and control of minerals is vested with the Crown. The land officer is empowered to grant mining leases, while the commissioner of mines is empowered to grant mining and prospecting licenses. At yearend 1976, there were three mining leases, nine mining licenses, and one prospecting license in effect.

Table 2.—Hong Kong: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite and concentrate	6,287	13,014
Oxide and hydroxide	302	222
Metal including alloys, all forms	18,991	9,458
Arsenic trioxide, pentoxide, acids	17	55
Chromium oxide and hydroxide	19	65
Cobalt oxide and hydroxide	4	(1)
Copper:		
Oxide and hydroxide	2	2
Metal including alloys, all forms	8,628	5,757
Gold metal, unworked or partly worked ---thousand troy ounces--	308	1,975
Iron and steel:		
Ore and concentrate ---thousand tons--	179	164
Scrap ---do---	r 258	159
Pig iron, steel ingot, similar materials ---do---	r (1)	1
Semimanufactures ---do---	r 73	16
Lead:		
Oxide	11	1
Metal including alloys, all forms	r 2,050	1,395
Magnesium metal including alloys, all forms	144	4
Manganese oxide	30	49
Nickel:		
Oxide and hydroxide	3	5
Metal including alloys, all forms	r 191	114
Silver metal including alloys ---thousand troy ounces--	2,011	2,833
Tin metal including alloys, all forms	432	531
Titanium oxide	609	340
Tungsten metal including alloys, all forms	7	12
Zinc:		
Oxide	81	38
Metal including alloys, all forms	r 3,387	541
Other:		
Oxides, hydroxides, peroxides of metals, n.e.s	92	16
Metals including alloys, all forms:		
Metalloids	5	(1)
Base metals including alloys, all forms	48	45

See footnotes at end of table.

Table 2.—Hong Kong: Exports and reexports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975
NONMETALS		
Abrasives:		
Natural, n.e.s	34	29
Grinding and polishing wheels and stones	r 155	397
Asbestos	21	50
Barite and witherite	87	22
Cement, hydraulic	22,054	2,816
Clays and clay products (including all refractory brick):		
Crude	28,749	20,968
Products, value, thousands	$1,727	$930
Cryolite and chiolite	30	--
Diamond:		
Gem, not set or strung, thousand carats	r 351	335
Industrial, value, thousands	$7	$42
Diatomaceous earth	38	15
Feldspar and fluorspar	406	161
Fertilizer materials:		
Crude	176	43
Manufactured	1	5
Ammonia	r(1)	(1)
Graphite, natural	2,031	2,559
Gypsum and plaster	154	284
Lime	180	85
Mica, all forms	42	28
Pigments, mineral, including processed iron oxide	452	127
Precious and semiprecious stones, including synthetic, other than diamond, value, thousands	r $89,098	$95,844
Salt and brine	111	10
Sodium and potassium compounds, n.e.s	9,192	4,138
Stone, sand and gravel:		
Dimension stone	1,545	2,210
Gravel and crushed rock	49	45
Quartz and quartzite	608	470
Sulfur:		
Elemental, all forms	64	238
Sulfuric acid	1	7
Talc, steatite, soapstone, pyrophyllite	1,508	226
Other:		
Crude	189	306
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	258	3
MINERAL FUELS AND RELATED MATERIALS		
Carbon black and gas carbon	80	32
Coal and coke, including briquets	r 410	576
Petroleum refinery products:		
Gasoline, thousand 42-gallon barrels	51	58
Kerosine, do	32	29
Distillate fuel oil, do	489	449
Residual fuel oil, do	r 40	57
Lubricants, do	r 183	138
Mineral jelly and wax, do	54	23
Other, do	r 23	26
Mineral tar and other coal-, petroleum-, and gas-derived crude chemicals	6	2

r Revised.
1 Less than ½ unit.

Table 3.—Hong Kong: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite and concentrate	4,540	9,349
Oxide and hydroxide	433	483
Metal including alloys, all forms	r 35,743	30,744
Arsenic trioxide, pentoxide, acids	55	40
Chromium oxide and hydroxide	17	3
Cobalt oxide	36	36
Copper:		
Copper sulfate	68	87
Oxides and hydroxides	164	91
Metal including alloys, all forms	18,211	23,699
Gold metal, unworked and partly worked ---thousand troy ounces--	531	697
Iron and steel:		
Scrap ---thousand tons--	105	49
Pig iron, ferroalloys, similar materials ---do---	8	19
Steel, primary forms ---do---	81	74
Semimanufactures ---do---	495	430
Lead:		
Oxides, n.e.s	172	90
Metal including alloys, all forms	1,946	707
Magnesium metal including alloys, all forms	111	--
Manganese:		
Ore and concentrate	680	620
Oxides	r 2,132	1,053
Mercury ---76-pound flasks--	986	929
Nickel:		
Oxides	55	48
Metal including alloys, all forms	743	352
Platinum-group metals including alloys, all forms ---thousand troy ounces--	93	186
Rare-earth oxides	7	4
Silver metal including alloys, all forms ---thousand troy ounces--	823	1,383
Tin metal including alloys, all forms	698	637
Titanium:		
Ore and concentrate	150	90
Oxides	3,196	2,256
Tungsten metal including alloys, all forms	r 2	141
Zinc:		
Oxides	527	514
Metal including alloys, all forms	r 91	r 24
Other:		
Ashes and residue containing nonferrous metals	140	--
Oxides, hydroxides, peroxides of metals, n.e.s	137	24
Metals including alloys, all forms:		
Metalloids	39	35
Base metals including alloys, all forms	r 59	63
NONMETALS		
Abrasives:		
Natural, n.e.s	550	376
Dust and powder of precious stones ---value--	$9,680	$14,402
Grinding and polishing wheels and stones	1,031	968
Asbestos	68	907
Barite and witherite	265	198
Boric acids	276	204
Cement, hydraulic ---thousand tons--	1,337	1,153
Clays and clay products (including all refractory brick):		
Crude	12,174	13,118
Products ---value, thousands--	$15,219	$15,072
Cryolite and chiolite	36	10
Diamond:		
Gem ---thousand carats--	1,023	1,005
Industrial ---value, thousands--	$601	$63
Diatomaceous earth	267	142
Feldspar and fluorspar	1,127	1,910
Fertilizer materials:		
Crude	1,095	643
Manufactured:		
Nitrogenous	3,097	2,836
Phosphatic	120	71
Potassic	10	--
Other, including mixed	5,575	6,268
Ammonia	628	412
Graphite	2,359	2,890
Gypsum and plaster	31,571	25,542
Lime	34,299	34,885
Magnesite	533	679

See footnote at end of table.

Table 3.—Hong Kong: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity		1974	1975
Mica, all forms		95	128
Pigments, mineral, including processed iron oxide		657	192
Precious and semiprecious stones, including synthetic, other than diamond	value, thousands	r $52,100	$50,339
Salt		46,377	42,162
Sodium and potassium compounds, n.e.s		23,726	22,598
Stone, sand and gravel:			
Dimension stone		r 14,622	8,572
Gravel and crushed rock		83,280	227,780
Limestone, except dimension		7,312	6,154
Quartz and quartzite		2,474	1,387
Sand, excluding metal bearing		2,212	900,212
Sulfur:			
Elemental, all forms		2,419	2,012
Sulfuric acid		330	1,611
Talc and related material		2,765	1,353
Other:			
Crude		4,560	5,124
Mineral waste		882	1,796
Oxides and hydroxides of magnesium, strontium, barium		28	7
Fluorine, bromine, iodine		1	(1)
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s		12,023	14,487
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural		320	16
Carbon black and gas carbon		580	489
Coal, coke, and peat, including briquets		r 15,891	14,346
Petroleum refinery products:			
Gasoline, including natural	thousand 42-gallon barrels	1,130	984
Kerosine, aviation, and industrial and white spirits	do	5,912	6,111
Diesel and distillate fuel oil	do	r 7,224	6,612
Residual fuel oil	do	r 20,129	18,162
Lubricants	do	501	271
Mineral jelly and wax	do	101	51
Other:			
Bitumen and other mixtures	do	151	128
Liquefied petroleum gas	do	890	875
Pitch	do	r 452	326
Unspecified	do	r 14	89
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals		118	35

r Revised.
1 Less than ½ unit.

LAOS [13]

The first full year of the People's Democratic Republic of Laos saw little economic progress. The rate of inflation rose steadily and was probably the worst of any nation in the world during 1976.[14] The Lao kip (K), with no stabilizing foreign backing, began the year at K4,000 to the U.S. dollar. Six months later, its value had fallen to K14,000 to the U.S. dollar. The Government declared a currency exchange at midyear; new currency was issued and the inflationary pressure on the kip was lessened. The Government's official exchange rate, however, did not realistically reflect true market prices, and upward pressure on the kip resumed.

The flow of foreign goods, imported through Thailand, was tightly controlled to stop the drain on valuable foreign exchange. By yearend 1976, Thai imports had been reduced to only the most essential items and replacement parts which could not be made domestically. Most of the private merchants in Vientiane were forced to close as it became impossible to make a profit under the prevailing conditions.

Reconstruction and expansion of the road network continued to be a major goal of the Lao Government, but results were modest. The road network was so poor that surplus rice produced in the southern provinces could not be efficiently moved into the northern and central provinces, where rice had to be imported. The poor state of the roads was aggravated by the with-

[13] Prepared by Gordon L. Kinney.
[14] Far Eastern Economic Review. Asia 1977 Yearbook (Hong Kong). Dec. 21, 1976, pp. 212–218.

drawal in 1975 of U.S. aid which formerly provided nearly all of the road maintenance funds. Dissidents operating in the highlands harassed the road repair units and slowed construction progress.

Expansion of the Nam Ngum hydroelectric station got underway during the year. Plant capacity is to be increased from 30 megawatts to 110 megawatts when the project is completed, with the increased output to be mostly exported to Thailand. Laos earned about $1 million per year by selling Nam Ngum power to Thailand. The second small hydroelectric powerplant in Houaphanh Province in northern Laos was completed in April. The plant was to supply power to the industries in the Samtay District. Total installed generating capacity in Laos was about 55 megawatts at year-end 1976.

The mineral industry continued to be a minor factor in the Lao economy. The only important mineral production was again that of tin concentrate. The mines were located at Phon Tiou, about 80 kilometers north of Thakhek. They were reportedly managed by the French firm Société d'Études et d'Exploitations Minières de l'Indochine, but no production figures were available for 1976. Presumably production remained similar to that of previous years at over 500 tons of tin-in-concentrate.

A consortium of Japanese and U.S. companies that was interested in developing iron ore deposits in the Plain of Jars in Xieng Khouang Province has apparently lost interest in the venture, and there were no further developments during 1976.

Developing the rich potash deposits that were explored during 1974–75 has also been put off, pending better economic conditions. The deposit is one of the best in Southeast Asia but would have required a large capital investment for mine, processing plant, and infrastructure before production could begin.

A salt mine was opened in January in Kong hamlet, Thoulakhom District, Vientiane Province. Production in the first quarter of 1976 was reportedly 1,000 tons. Refined salt was consumed for domestic needs locally and in nearby provinces.

Laos produced no crude oil or natural gas during 1976. Its fuel needs were met by modest imports of petroleum products from Thailand.

MONGOLIA [15]

In 1976, the Mongolian People's Republic entered the first year of its sixth 5-year plan which envisioned converting the country from an agrarian society to an industrial-agrarian economy. To implement the process of industrialization, the major goal of the sixth plan was to begin a program of extensive electrification of the country. Plans were made to supply electrical energy to new industrial sites and areas and to the main economic regions. The power system of Mongolia was to be linked to power grids within the U.S.S.R., thereby affording several important advantages: The reliability of electrical energy would be enhanced; funds, fuels, and materials would be available for expenditure on other projects; and the use of more powerful equipment would be made possible.

The overall volume of capital investment in the national economy under the sixth plan would nearly double that of the prior plan. As a result, the national fixed production capital would increase about 80%, with that for agriculture increasing about 50% and that for industry more than 200%. During the sixth plan, the country's labor resources would be increased by about 100,000 persons, and the labor force involved in material production would increase about 14%. Two-thirds of the gain in national income was to be obtained through a 24% increase in labor productivity. The gross industrial output and the gross agricultural output were to increase 62.9% and 30%, respectively, over those of the previous 5-year period.

In 1976, total Governmental expenditure was estimated at $847 million, distributed between the State budget ($532 million) and local budgets ($315 million). The allocation of expenditures by sector was as follows, in million dollars: Social and cultural services, 365; national economy, 335; defense, 103; administration, 40; and unspecified, 4. Total Government spending in 1977 was projected at $940 million. Planned expenditures for 1977 include $168 million for trade, supplies, and services, $90 million for agriculture, $46 mil-

[15] Prepared by E. Chin.

lion for transport and communications, and $41 million for industry. The nation's gross industrial production in 1977 was projected to increase 6% over that of 1976. The growth rate of industrial production was expected to speed up in the last 2 years of the sixth plan when the Erdenet copper and molybdenum mine complex goes into operation.

Coal mining is Mongolia's foremost mineral industry. During 1976, production of lignite and brown coal was estimated at 2.6 million tons and anthracite and bituminous coal at 200,000 tons. About 74% of the country's coal output came from open pit mines, with the bulk of the production from coal mining areas in Nalayha, Sharyn Gol, and Chuluun. The Government envisaged the development of the Tavantolozy coal deposit in South Gobi Province which may have up to 1 billion tons of reserves. The coal is apparently suitable for use in ferrous and nonferrous metallurgy. A large open cast mine complex capable of producing 10 million tons of high-quality coking coal per year reportedly could be established at the deposit. In addition, plans were underway to develop a coal deposit at Baga Nuur into a 2-million-ton-per-year mine by 1980.

About 300,000 tons of fluorspar was produced from a mine at Berhin in 1976. Output from this mine constituted about 7% of total world production of fluorspar. A large expansion program was slated for the Berhin mine under the provisions of the sixth plan.

Output of tungsten from the Burentsogt mine and from a scheelite deposit on Hayrhan Mountain ranges between 100 and 200 tons of concentrates annually. Estimated output of other mineral products was as follows, in tons: Gypsum, 25,000; lime, 40,000; and salt, 11,000. During the year, the cement plant at Darhan produced about 160,000 tons of cement.

Most of Mongolia's trade is with the U.S.S.R. Mineral imports include coal, coke, petroleum, and semimanufactured steel products for structural applications. Tungsten concentrates and metallurgical-grade fluorspar were the major minerals exported. Output of gypsum, lime, and salt was presumably all domestically consumed. A small oil refinery at Dzüün Bayan produced kerosine and residual fuel oil.

Mongolia is a member of the Council for Mutual Economic Assistance (CMEA). Other members are Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Poland, Romania, and the U.S.S.R. Cooperation among the members includes joint geological research, providing special credits including funds from the CMEA International Investment Bank, and promoting the efficient use of resources. The CMEA was planning a joint development project for coking coal in Tavan-Tolgoi, Shazingol, Nalaikha, and other locations in Mongolia. Additionally, the CMEA was conducting studies on the construction of a smelter to utilize material from a copper mine and concentrating plant at Chagan Suburga, and another smelter based on a tungsten-molybdenum deposit at Ugodzir.

Development of the copper-molybdenum deposit at Mt. Erdenetun-obo is the major industrial project in north-central Mongolia near the Selenga River.[16] The copper-bearing ore zone was described as massive, measuring 25 kilometers long by 2.7 kilometers wide. Preliminary drilling indicated that the ore-bearing zone extends to a depth of 500 meters. Four other copper-bearing zones were reportedly found in the area. Total copper ore resources in the area were estimated at 1 billion tons containing approximately 9 million tons of copper. Because of this extensive mineral resource, the Government of Mongolia decided to build a modern city rather than a mining settlement. In addition to the mine and ore-dressing facilities, plans for Erdenet city included a carpet-making plant and a woodworking plant. By 1979, four apartment blocks would be completed to house some 15,000 people. Six additional apartment blocks were planned for construction to accommodate an additional 15,000 people by the 1980's. Five secondary schools, a boarding school, and a mining college were scheduled for construction, as well as a library, automobile service shop, sports center, and other public amenities.

The main highway to the principal western cities of Mongolia runs through Erdenet. The city is also serviced by a recently built railroad and high-voltage power transmission lines. Water from the

[16] Mongolia (Ulan Bator). City at a Copper Mountain. No. 6, 1976, pp. 16–21.

Selenga River was diverted by a pipeline to Erdenet. When completed in 1980, it was estimated that the annual industrial output value at Erdenet would be 40% more than the country's total industrial output in 1975, through the production of possibly 15 million tons of copper-molybdenum ore.

NEPAL [17]

Agriculture accounted for about two-thirds of Nepal's estimated $1.8 billion [18] GDP in fiscal 1976,[19] employing over 90% of the 13 million people. The mining, manufacturing, construction, and transportation sectors of the economy together accounted for about 8% of the GDP. Mining alone accounted for less than 0.1%. Actually, Nepal has no mineral, fuel, power, or other industries of consequence by world standards.

Economic growth continued to be slow during the year, with the modest gains nearly cancelled by the 2.5% annual population growth. The Government of Nepal, with considerable foreign assistance, continued to expand its development activities. The main thrust has been toward improving the infrastructure. The first motor vehicle road in Nepal, from the Indian border to Katmandu, was opened just 25 years ago. Road construction has been a major goal of the Government since then, with the total mileage of motor vehicle roads nearly double that of 1969. Several highway projects were underway which will furnish the first east-west highway links across the country when completed. One of the most ambitious projects was the 407-kilometer Pokhara-Surkhet highway through the rugged Himalayan foothills. The road was being built with over $75 million in Chinese economic assistance. Opening of hitherto inaccessible areas to motor vehicles will facilitate mineral exploration.

Development of the vast hydroelectric potential of the country also ranked high on the Government's list of priorities. The total installed hydroelectric capacity was about 34,000 kilowatts at the beginning of 1976. Currently under construction about 30 kilometers southwest of Katmandu was the Kulekhani hydroelectric system. First-stage capacity was planned at 32,000 kilowatts with an additional 26,000 kilowatts to be installed after first-stage completion. This will be the largest powerplant in the country at its scheduled completion in 1980. Other major projects were also underway or in the design stage. With no fossil fuels currently being produced in the country, the hydroelectric expansion and accompanying irrigation facilities will be an important factor in future industrial and economic development.

The United Nations Development Program (UNDP) was assisting in a systematic exploration program that will cover three 8-month field seasons. The $2 million cost will be shared by the UNDP and the Nepalese Government. The basic program was to introduce sophisticated exploration techniques and establish continuing geological programs in the country. A 15,000-square-kilometer area in central Nepal was selected to inaugurate the program, which was organized in 1975. Writing of a modern mining code was also part of the program, and a draft of the new legislation was completed in 1976.

A new Department of Mines and Geology was formed in July 1976 from the former independent Mines Office and the Department of Irrigation and Geology.

Nepal's cement production nearly tripled as the Himal cement plant completed its first full year of operation in fiscal 1976. The plant operated at about 60% of its 50,000-ton-per-year design capacity, turning out over 29,500 tons valued at $1.8 million. The value of the cement was several times the combined value of all other mineral production in Nepal in 1976. The Himal plant did not have sufficient capacity to supply the country's present 160,000- to 170,000-ton annual demand for portland cement. The planned 260,000-ton-per-year Hetauda cement plant project received a $39.5 million loan from the Asian Development Bank to cover the foreign exchange component of the $59 million total cost. The Bank approved the loan in November 1976. The additional capacity should make Nepal independent of expen-

[17] Prepared by Gordon L. Kinney.
[18] Where necessary, values have been converted from Nepalese rupees (NRs) to U.S. dollars at the rate of NRs12.5=US$1.00.
[19] The Nepalese fiscal year is the year ending July 16 of that stated.

sive imported cement when the new plant opens in 1981.

It was reported that the Nepal Mining Co. had begun development of the Ganesh Himal zinc mine at Lari, 56 kilometers northwest of Katmandu. A road was under construction to the property. Shaft sinking was expected to be completed in 1979. A 25,000-ton-per-year concentrator was planned to be completed in 1981. The company was reportedly 50% Nepalese owned and 50% jointly held by an Indian and a U.S. firm.

The Department of Mines and Geology, in conjunction with an Indian company, was conducting a feasibility study on a 50,000-ton-per-year electrothermal steel plant. The plant would be based on the Phulchoki iron ore deposit 26 kilometers southeast of Katmandu. The 3.6 million tons of ore reserves are probably adequate for the project and limestone is also available nearby. However, the proposed use of wood charcoal as the reductant would deplete the local Nepalese forest resources and would be highly labor intensive and expensive.

Nepal produced no mineral fuels in 1976 and was totally dependent on imports for its petroleum needs. Imports rose slightly in 1976 to a total of 79,100 tons. The petroleum products imported were jet fuel and kerosine (34,600 tons) and fuel and diesel oils (36,500 tons). The U.S.S.R. supplied nearly the entire amount through an exchange arrangement with India.

SINGAPORE [20]

Singapore achieved a 9% economic growth rate in 1976, with the gross national product (GNP) reaching an estimated $5,886 million [21] in current prices. The real growth rate was closer to 7%, which was the general level that Government planners expected for 1977. Once one of Asia's star performers, the Singapore economy was entering a phase of consolidation and slower growth than in the late 1960's and early 1970's, although the growth was still well above the average for developing countries. The slowdown began with the international oil crisis, which is understandable in view of the special importance of petroleum activities to the economy. The prolonged slump in several leading industries, such as petroleum refining, oil rig construction, shipping, and shipbuilding, which was partly caused by the sluggish economies of Japan, Western Europe, and the United States, appeared to be ending in late 1976.

Until a few years ago, Singapore, with a population of only 2.3 million, could have been described as a nation of import-export merchants. Entrepôt trade was still the dominant part of the economy in 1976, with services (including the hotel and restaurant trade) accounting for about 70% of the GNP, and total foreign trade amounting to 270% of the GNP. However, petroleum-related activities, advanced technology in manufacturing industries, and financial and communications activities have steadily gained ground. The value of manufacturing rose 11.5% to $1.37 billion and that of construction rose 13% to $489 million in 1976. Foreign investments have played a significant role. Combined foreign and domestic plant and equipment investment for Singapore was $1.13 billion in 1975 and $1.08 billion in 1976.

The petroleum industry, posting a sharp increase in output, was by far Singapore's most important manufacturing component in 1976. Oil refineries were upgrading their processing facilities, and the projected Sumitomo Chemical Co., Ltd., petrochemical complex, if launched, would provide some stimulus to the industry.

The electronics industry boomed. Foreign demand for electrical and electronic goods sparked a large increase in investment, and three-fourths of all new manufacturing jobs were in the electronics industry.

Shipbuilding and repair activity declined nearly 10%, brought about mainly by the reduced level of regional oil exploration. The ship repair sector, however, recovered in the second half of 1976 as many shipyards turned to heavy engineering work, such as construction of offshore structures for oil activities and engineering fabrication for powerplants, chemical plants, and

[20] Prepared by K. P. Wang, supervisory physical scientist.

[21] Where necessary, values have been converted from Singapore dollars (S$) to U.S. dollars at the rates of S$2.45=US$1.00 in 1976 and S$2.39=US$1.00 in 1975.

harbor facilities. Singapore has been the world's fourth largest port for several years.

Alongside the progress in industry, trade, and tourism, Singapore made headway toward becoming a major international financial center through development of its Asian dollar market, gold market, and secondary money market. Plans were underway to create a gold exchange, similar to the Winnepeg Exchange, involving both spot and future contracts based upon certificates of gold deposits issued by authorized banks. This gold exchange, initiated by the Singapore Chamber of Commerce Rubber Association, was expected to be operational by yearend 1977. With regard to trade, Singapore's foreign reserve position improved from $3.13 billion at yearend 1975 to $3.37 billion at yearend 1976.

PRODUCTION

In 1976, Singapore produced about $2,517 million worth of petroleum products by processing $2,243 million worth of crude oil with about 3,350 workers, thereby earning $274 million in value added.[23] In 1975, output was $1,989 million, input was $1,736 million, and value added was $253 million. Residual fuel oil ranked first in tonnage, followed by distillate fuel oil, jet fuel, gasoline, kerosine, and lubricants, in that order. The refining industry had not recovered from the loss of the Vietnamese market and the reluctance of Japan to buy its refined oil. However, refining capacity utilization increased to 55% in 1976. Singapore had been producing over 2.3 million cubic yards of granite annually in recent years; in 1976, output increased to 3.3 million cubic yards.

Singapore's mineral economy shows a pattern of processing foreign raw materials (and/or intermediate materials) and domestic scrap into finished products. More than 1 million tons of cement was produced for the sixth consecutive year to sustain high levels of construction, but the principal raw material was actually imported clinker. The 230,000 tons of ingot steel produced in 1976 was from scrap; Singapore also imported much larger tonnages of steel products and semimanufactures, some of which was converted to additional downstream products. The country's statistics show that value added for cement in 1976 was $23 million; concrete products, $9 million; other nonmetallic minerals, $13 million; iron and steel, $22 million; and nonferrous metals, $5 million. The country's mineral production statistics are shown in table 1.

TRADE

Singapore's total foreign trade came to $15.78 billion in 1976, compared with $13.40 billion (revised) in 1975 when the Singapore dollar was worth slightly more. Exports (f.o.b.) rose 25% to $6.64 billion, and imports (c.i.f.) rose 14% to $9.14 billion in 1976. The trade deficit was more than offset by income from services such as tourism, banking, insurance, and shipping, and by capital inflow from abroad. In fact, a net balance-of-payments surplus of $293 million was registered in 1976. These figures do not include trade with Indonesia.

Singapore's most important trading partner in 1976 was the United States, with exports of $0.98 billion and imports of $1.21 billion, 14.8% and 13.2%, respectively, of the totals. Japan was second, with exports of $0.68 billion and imports of $1.47 billion, followed by West Malaysia with imports of $1.05 billion. Other important trading areas included Hong Kong, the United Kingdom, Australia, West Germany, East Malaysia (Sabah and Sarawak), Thailand, the People's Republic of China, France, the Netherlands, and Italy.

In terms of commodity groups, Singapore's most important exports in 1976 were machinery and equipment (25.3%), mineral fuels (23.3%), crude inedible materials (16.4%), manufactured materials (8.2%), food and live animals (5.8%), and chemicals (3.7%). The most important imports were mineral fuels (27.4%), machinery and equipment (25.9%), manufactured materials (14.6%), crude inedible materials (9.0%), food and live animals (8.3%), and chemicals (5.0%).

The entrepôt nature of Singapore's economy is self-evident in these trade figures, and petroleum occupies a special position. In 1976, Singapore imported 21.3 million tons of crude oil and 6.2 million tons of refined oil, and exported 13.0 million tons of refined oil. Most of Singapore's crude oil imports came from Kuwait, Saudi

[23] Monthly Digest of Statistics (Singapore). V. 16, No. 6, June 1977, p. 17.

Arabia, and Iran. Its sales of refined oil went primarily to other Asian countries or for bunkering, in addition to the domestic market. Singapore's 1976 oil import bill was about $2.57 billion, but its refined oil exports were worth $1.58 billion, and monies earned from bunkering were sizable also.

Table 4.—Singapore: Exports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum:			
Bauxite and concentrate	1,030	450	Taiwan 400; Thailand 50.
Oxide and hydroxide	962	4,319	Mainly to Malaysia.
Metal including alloys:			
Scrap	(1)	2,512	Mainly to Pakistan.
Unwrought and semimanufactures	3,190	732	Mainly to Malaysia.
Chromium oxide and hydroxide	28	16	Do.
Cobalt oxide and hydroxide	(2)	1	All to Malaysia.
Copper:			
Sulfate	220	183	Mainly to Malaysia.
Metal including alloys:			
Scrap	(1)	4,471	Pakistan 2,319; Japan 615.
Unwrought and semimanufactures	1,408	1,804	Mainly to Malaysia.
Iron and steel:			
Roasted pyrite	1	--	
Metal:			
Scrap	1,945	1,539	Taiwan 781; Netherlands 706.
Pig iron, ferroalloys, similar materials	7,685	7,702	Mainly to Malaysia.
Steel, primary forms	15,676	8,448	Do.
Semimanufactures:			
Bars, rods, angles, shapes, sections	65,099	55,848	Malaysia 42,133; Brunei 10,278.
Universals, plates, sheets	82,904	41,631	Mainly to Malaysia.
Hoop and strip	1,949	1,161	Do.
Rails and accessories	6,126	2,081	Do.
Wire	3,378	2,785	Malaysia 2,066; Brunei 516.
Tubes, pipes, fittings	44,599	74,484	Brunei 39,918; Malaysia 6,709.
Castings	680	762	Malaysia 481; United States 124.
Total	204,735	178,752	
Lead:			
Ore and concentrate	2	21	India 13; Pakistan 7.
Oxides	19	51	Mainly to Malaysia.
Metal including alloys:			
Scrap	(1)	627	Malaysia 275; Taiwan 175; Thailand 100.
Unwrought and semimanufactures	1,073	646	Mainly to Malaysia.
Manganese:			
Ore and concentrate	2,404	2,808	Malaysia 920; Kenya 773; Sri Lanka 389.
Oxides	44	61	Mainly to Malaysia.
Mercury, 76-pound flasks	17	13	Malaysia 11; Brunei 2.
Nickel metal:			
Scrap	(1)	255	Belgium-Luxembourg 100; Switzerland 48; Netherlands 36.
Unwrought and semimanufactures	44	35	Malaysia 28; Thailand 6.
Platinum-group metals and silver:			
Waste and sweepings, kilograms	25,690	721	United Kingdom 450; Australia 144.
Metals including alloys:			
Platinum-group, thousand troy ounces	108	84	Mainly to United Kingdom.
Silver, do.	308	75	Do.
Thorium ore and concentrate, kilograms	NA	1,414	All to Burma.
Tin:			
Ore and concentrate	1,629	2,343	Spain 821; U.S.S.R. 800; Mexico 558.
Metal including alloys:			
Scrap	(1)	71	Denmark 39; United Kingdom 32.
Unwrought and semimanufactures	661	596	Malaysia 177; Taiwan 134.
Titanium:			
Ore and concentrate	--	7	All to Bangladesh.
Oxides	537	416	Mainly to Malaysia.
Tungsten:			
Ore and concentrate	80	13	North Korea 10; United Kingdom 3.
Metal including alloys, all forms	NA	246	Mainly to Malaysia.

See footnotes at end of table.

Table 4.—Singapore: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS—Continued			
Zinc:			
Ore and concentrate	100	20	All to Malaysia.
Oxides and peroxides (except hydroxides)	17	110	Malaysia 46; Kenya 28; Hong Kong 21.
Metal including alloys:			
Scrap and blue powder	(1)	287	Taiwan 125; Japan 116.
Unwrought and semimanufactures	3,702	2,202	Malaysia 1,181; Thailand 890.
Other:			
Ores and concentrates of base metals, n.e.s. (excluding iron and magnesium)	104	3	All to Malaysia.
Ash and residue containing nonferrous metals	7,014	4,717	Malaysia 2,208; Hong Kong 1,309; United Arab Emirates 501.
Oxides, hydroxides, peroxides of metals, n.e.s	51	33	Mainly to Malaysia.
Metals including alloys, all forms:			
Scrap, nonferrous	7,443	(3)	
Metalloids	18	35	All to Malaysia.
Alkali, alkaline earth, rare-earth metals	11	15	Do.
Base metals including alloys, all forms, n.e.s	88	1,251	Iran 600; Netherlands 460.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	94	63	Pakistan 29; Malaysia 26.
Grinding and polishing wheels and stones	285	155	Malaysia 113; Philippines 14.
Asbestos	3,150	1,670	Malaysia 1,012; Vietnam 290.
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin	244	144	Taiwan 100; Malaysia 43.
Other	5,715	11,837	Philippines 2,975; Brunei 2,138.
Products:			
Refractory (including nonclay bricks)	749	1,372	Mainly to Malaysia.
Nonrefractory[4]	6,075	4,529	Malaysia 3,030; Brunei 1,272.
Diamond:			
Gem, not set or strung—value, thousands	r $2,259	$8,186	Mainly to Hong Kong.
Industrial ——do——	$455	--	
Feldspar and fluorspar	4,366	1,529	Mainly to Malaysia.
Fertilizer materials:			
Crude:			
Nitrogenous	r 7	2	All to Malaysia.
Phosphatic	17,959	33,467	Malaysia 24,023; Burma 8,125.
Manufactured:			
Nitrogenous	28,808	21,845	Mainly to Malaysia.
Phosphatic	11,166	6,324	Burma 3,800; Malaysia 2,498.
Potassic	182,968	134,740	Mainly to Malaysia.
Other, including mixed	113,636	17,623	Malaysia 13,468; Pakistan 3,826.
Ammonia	469	336	Mainly to Malaysia.
Graphite, natural	55	130	Taiwan 50; Malaysia 39.
Gypsum and plasters	815	357	Malaysia 248; Thailand 61.
Lime	3,813	2,375	Malaysia 1,532; Brunei 700.
Magnesite	81	58	All to Malaysia.
Mica, all forms	105	314	Philippines 100; Burma 77.
Pigments, mineral:			
Natural, crude	774	69	Mainly to Malaysia.
Iron oxides, processed	364	102	Do.
Precious and semiprecious stones, including synthetic, except diamond value, thousands	$1,177	$1,124	Hong Kong $853; Japan $142.
Salt	12,153	12,408	Malaysia 6,496; Brunei 4,851.
Sodium and potassium compounds, n.e.s	r 14,839	7,938	Mainly to Malaysia.
Stone, sand and gravel:			
Dimension stone	571	1,961	Malaysia 1,061; Brunei 891.
Dolomite, chiefly refractory grade	16	--	
Gravel and crushed rock	9,435	18,241	Brunei 16,700; Malaysia 1,478.
Limestone	416	212	Mainly to Malaysia.
Quartz and quartzite	(2)	2	All to Malaysia.
Sand, excluding metal bearing	3,413	1,179	Malaysia 758; Brunei 270.

See footnotes at end of table.

Table 4.—Singapore: Exports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
NONMETALS—Continued			
Sulfur:			
Elemental:			
Other than colloidal	18,223	15,541	Mainly to Malaysia.
Colloidal	8,036	5,394	Thailand 3,000; Hong Kong 1,500.
Sulfur dioxide	2	1	Mainly to Malaysia.
Sulfuric acid	1,014	1,505	United Arab Emirates 587; Malaysia 462; Sri Lanka 420.
Talc, steatite, soapstone, pyrophyllite	1,150	807	Mainly to Malaysia.
Other:			
Crude	70,832	16,959	Do.
Slag, dross, and similar waste, not metal bearing	112	857	Mainly to Brunei.
Oxides and hydroxides of magnesium, strontium, barium	2	9	Mainly to Malaysia.
Bromine, iodine, fluorine ---value	$1,289	$1,386	Do.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	47	577	Do.
Carbon black	2,076	1,285	Malaysia 946; Thailand 268.
Coal, all grades, including briquets	4,134	301	Brunei 137; Burma 59; Bangladesh 45.
Coke	2,610	3,518	Mainly to Malaysia.
Hydrogen, helium, rare gases value, thousands	$213	$198	Malaysia $87; India $54.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	73	1,886	Japan 829; Thailand 678; Malaysia 379.
Refinery products: [5]			
Gasoline:			
Aviation ---do	1,634	670	Australia 170; Vietnam 128; Thailand 95.
Motor ---do	7,676	6,276	Malaysia 1,654; Australia 741.
Kerosine and jet fuel ---do	17,216	14,343	United States 4,501; Hong Kong 3,669; Malaysia 1,353.
Distillate fuel oil ---do	27,550	20,151	Malaysia 6,021; Thailand 3,424; Australia 2,948.
Residual fuel oil ---do	46,456	34,191	Hong Kong 12,770; Japan 8,629; Malaysia 1,938.
Lubricants ---do	327	2,181	Malaysia 621; Thailand 541; India 213.
Mineral jelly and wax ---do	458	280	Japan 63; Philippines 35; Thailand 31.
Other:			
Naphtha ---do	--	10,634	Japan 4,517; New Zealand 1,582.
Nonlubricating oils, n.e.s ---do	19	29	Malaysia 15; Bahrain 4.
Pitch and petroleum coke---do	3	2	Mainly to Malaysia.
Bitumen and bituminous mixtures, n.e.s ---do	1,140	1,037	Australia 228; United Arab Emirates 164; Hong Kong 107.
Unspecified ---do	13,277	7,730	Japan 4,854; Thailand 188.
Total ---do	115,756	97,524	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	r 6 50	759	Malaysia 369; Thailand 318.

r Revised. NA Not available.

[1] Scrap, if any, is included under "Other scrap, nonferrous."

[2] Less than ½ unit.

[3] Listed under individual metals.

[4] Totals exclude bricks of baked clay valued at $32,218 in 1974 and $37,884 in 1975.

[5] In addition to the products listed, liquefied petroleum gas valued at $15,022,948 in 1974 and $17,733,428 in 1975 was exported.

[6] Excludes 1,481,049 liters of creosote oil.

Table 5.—Singapore: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum:			
Bauxite and concentrate	3,528	12,612	Mainly from Malaysia.
Oxide and hydroxide	4,207	2,255	Japan 981; People's Republic of China 900.
Metal including alloys:			
Scrap	(1)	352	Mainly from Malaysia.
Unwrought and semimanufactures	16,709	8,934	Japan 1,962; Hong Kong 1,042.
Chromium oxide and hydroxide	103	81	United States 23; United Kingdom 20; People's Republic of China 13.
Cobalt oxide and hydroxide	3	(2)	Mainly from Australia.
Columbium and tantalum metals--kilograms	NA	128	West Germany 100; Switzerland 28.
Copper:			
Ore and concentrate	--	2	All from Mozambique.
Metal including alloys:			
Scrap	(1)	1,497	Mainly from Malaysia.
Unwrought and semimanufactures	9,523	11,162	Japan 6,775; Australia 916.
Iron and steel:			
Ore and concentrate	10,134	23,712	Mainly from Malaysia.
Metal:			
Scrap	33,099	96,052	United States 74,594; Australia 12,219.
Pig iron, including cast iron	26,261	71,901	North Korea 38,438; India 22,020.
Sponge iron, powder, shot	343	887	Japan 474; India 128; United States 94.
Ferroalloys:			
Ferromanganese	2,520	1,562	Taiwan 1,132; Japan 345.
Other	2,023	1,444	Japan 795; Taiwan 530.
Steel, primary forms	38,052	101,279	Japan 50,312; North Korea 24,710; Australia 13,388.
Semimanufactures:			
Bars, rods, angles, shapes, sections	364,085	355,042	Mainly from Japan.
Universals, plates, sheets	574,265	435,857	Do.
Hoop and strip	33,463	12,608	Do.
Rails and accessories	10,500	10,899	United Kingdom 5,823; Japan 1,063.
Wire	17,546	13,381	Japan 8,876; Malaysia 1,129.
Tubes, pipes, fittings	310,325	[3] 305,303	Japan 195,206.
Castings and forgings, rough	2,903	4,812	Japan 2,052; United States 922.
Total	1,313,087	1,137,902	
Lead:			
Ore and concentrate	4	10	All from Morocco.
Oxides	458	548	Mainly from Australia.
Metal including alloys:			
Scrap	(1)	191	United States 99; Malaysia 55.
Unwrought	3,524	2,590	Mainly from Australia.
Semimanufactures	r 72	456	Australia 240; United Kingdom 124.
Magnesium metal, unwrought and semimanufactures	NA	13	Japan 9; United States 3.
Manganese:			
Ore and concentrate	4,932	23,709	United States 8,577; Ghana 6,837.
Oxides	813	538	Japan 230; United States 191; India 116.
Mercury--76-pound flasks	331	7	Australia 3; United States 2.
Molybdenum metal including alloys, all forms	NA	27	Netherlands 20; United States 6.
Nickel metal including alloys:			
Scrap	(1)	9	All from Malaysia.
Unwrought and semimanufactures	283	141	Australia 52; Japan 26.
Platinum-group metals and silver:			
Platinum-group--troy ounces	354	2,025	West Germany 643; United Kingdom 547; Hong Kong 354.
Silver--do	548,587	223,897	Japan 83,431; United States 33,662.
Tin:			
Ore and concentrate	23	37	Mainly from Thailand.
Oxides	(2)	2	Mainly from West Germany.
Metal including alloys:			
Scrap	(1)	205	Malaysia 104; Japan 101.
Unwrought and semimanufactures	1,088	1,244	Malaysia 846; Hong Kong 169.

See footnotes at end of table.

Table 5.—Singapore: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS—Continued			
Titanium:			
Ore and concentrate	144	196	Mainly from Sri Lanka.
Oxides	2,690	1,984	West Germany 586; Australia 493; Malaysia 376.
Tungsten:			
Ore and concentrate	71	10	Mainly from Thailand.
Metal including alloys, all forms	NA	52	Japan 18; United Kingdom 15; United States 15.
Zinc:			
Ore and concentrate—value	$194	$726	Mainly from United Kingdom.
Oxides and peroxides (except hydroxides)	888	336	United Kingdom 81; France 60; People's Republic of China 55.
Metal including alloys:			
Scrap	(1)	108	All from Malaysia.
Blue powder	(1)	528	Australia 413; Norway 60.
Unwrought and semimanufactures	r 11,990	9,739	Canada 4,818; Australia 2,277; Japan 2,053.
Zircon	126	31	Mainly from Australia.
Other:			
Ores and concentrates of base metals, n.e.s., including iron and magnesium	87	--	
Ash and residue containing nonferrous metals	18,597	52,446	Australia 38,858; Malaysia 6,387.
Oxides, hydroxides, peroxides of metals, n.e.s	290	175	Japan 60; West Germany 34; United Kingdom 34.
Metals including alloys, all forms:			
Scrap, nonferrous	15,581	(4)	
Metalloids	14	22	Japan 15; United States 6.
Alkali, alkaline earth, rare-earth metals	19	7	United Kingdom 4; United States 1.
Pyrophoric alloys	130	(2)	All from United States.
Base metals including alloys, n.e.s	115	1,237	Mainly from People's Republic of China.
NONMETALS			
Abrasives, natural, n.e.s.:			
Pumice, emery, natural corundum, etc	188	270	United States 62; Japan 43; India 40.
Dust and powder of precious and semi-precious stones—value	$6,447	$3,540	Japan $2,178; West Germany $700; Belgium-Luxembourg $662.
Grinding and polishing wheels and stones	792	724	Japan 296; Italy 77.
Asbestos	10,701	10,341	Canada 1,980; Australia 1,757; United States 1,724.
Cement—thousand tons	1,187	1,390	Republic of Korea 344.
Clays and clay products (including all refractory brick):			
Crude:			
Kaolin	4,171	2,464	Malaysia 2,064; United Kingdom 305.
Other	44,027	24,894	Mainly from United States.
Products:			
Refractory (including nonclay bricks)	12,256	12,520	United Kingdom 4,103; Austria 3,301.
Nonrefractory [5]	48,571	83,867	Czechoslovakia 36,184; Japan 18,551.
Diamond:			
Gem, not set or strung—value, thousands	$10,297	$15,798	Belgium-Luxembourg $6,548; India $5,330.
Industrial—value	$17,762	$11,744	Malaysia $9,015; West Germany $1,271.
Diatomite and other infusorial earth	490	604	West Germany 426; United States 101; Japan 67.
Feldspar and fluorspar	6,016	2,681	Mainly from India.
Fertilizer materials:			
Crude:			
Nitrogenous	--	30	All from United States.
Phosphatic	20,802	24,611	Mainly from Christmas Island.
Manufactured:			
Nitrogenous	67,322	37,323	Mainly from Japan.
Phosphatic	46,133	154,268	Netherlands 59,750; United States 44,630.

See footnotes at end of table.

Table 5.—Singapore: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS—Continued			
Fertilizer materials—Continued			
Manufactured—Continued			
Potassic	226,279	194,850	Canada 89,521; Israel 56,297.
Other, including mixed	94,829	67,900	United States 46,800.
Ammonia	608	294	Malaysia 163; United States 67; Japan 43.
Graphite, natural	199	198	Sri Lanka 110; People's Republic of China 50.
Gypsum and plasters	25,226	46,120	Australia 27,344; Japan 16,839.
Lime	8,631	16,067	Malaysia 13,225; People's Republic of China 1,100.
Magnesite	409	43	Japan 30; Malaysia 7; Australia 6.
Mica, all forms	2,258	882	United States 694; India 163.
Pigments, mineral:			
Natural, crude	212	290	People's Republic of China 180; United States 58; Spain 30.
Iron oxides, processed	1,979	725	West Germany 326; People's Republic of China 230; United States 85.
Precious and semiprecious stones, except diamond, worked and unworked:			
Natural ——value, thousands	$3,804	$9,486	Sri Lanka $2,691; Hong Kong $1,421.
Manufactured ——do	$110	$114	India $36; United Kingdom $27; Thailand $25.
Salt and brine	55,192	39,941	Mainly from Thailand.
Sodium and potassium compounds, n.e.s.:			
Caustic potash, sodic and potassic peroxides	554	311	Hong Kong 163; Belgium-Luxembourg 61; Japan 52.
Stone, sand and gravel:			
Dimension stone:			
Crude and partly worked	18,563	31,272	Mainly from Malaysia.
Worked	9,666	6,649	Italy 3,501; People's Republic of China 2,633.
Dolomite, chiefly refractory grade	2,110	485	Mainly from Malaysia.
Gravel and crushed rock	461,340	605,065	Do.
Limestone (except dimension)	26,851	15,041	Do.
Quartz and quartzite	178	179	Do.
Sand, excluding metal bearing	34,805	43,208	Do.
Sulfur:			
Elemental:			
Other than colloidal	2,861	2,627	Mainly from Japan.
Colloidal	3,414	474	United States 389; Japan 54.
Sulfur dioxide	3	2	Mainly from United Kingdom.
Sulfuric acid	100	86	Malaysia 38; United Kingdom 22; Japan 10.
Talc, steatite, soapstone, pyrophyllite	9,192	5,711	People's Republic of China 3,916; North Korea 1,001.
Other:			
Crude	146,147	32,646	West Germany 25,976; Malaysia 5,895.
Slag, dross, and similar waste, not metal bearing	3,036	5,971	Malaysia 2,954; Taiwan 2,800.
Oxides and hydroxides of magnesium, strontium, barium	46	37	West Germany 20; United States 11; Taiwan 5.
Bromine, iodine, fluorine ——value	$6,035	$15,047	Japan $5,648; Israel $4,940; United Kingdom $2,206.
Building materials of asphalt, asbestos, and fiber cement, and unfired nonmetals, n.e.s	12,400	5,338	Mainly from Malaysia.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	15	667	Republic of Korea 500; United States 122.
Carbon black	r 7,303	2,766	Japan 1,557; Australia 730; United States 405.
Coal, all grades, including briquets	2,671	1,589	Mainly from United States.
Coke	10,472	5,000	Japan 3,210; Taiwan 1,738.
Hydrogen, helium, rare gases value, thousands	$662	$401	United States $210; Japan $91.
Petroleum:			
Crude and partly refined thousand 42-gallon barrels	169,260	133,248	Saudi Arabia 52,275; Iran 25,438; Kuwait 21,262.

See footnotes at end of table.

Table 5.—Singapore: Imports of mineral commodities—Continued
(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
MINERAL FUELS AND RELATED MATERIALS —Continued			
Petroleum—Continued			
Refinery products: [6]			
Gasoline:			
Aviation thousand 42-gallon barrels	1,612	688	All from Iran.
Motor ---do---	1,425	1,314	Iran 720; Bahrain 383.
Jet fuel ---do---	966	1,820	Italy 481; Australia 474; Iran 310.
Kerosine ---do---	1,600	1,659	Malaysia 643; Saudi Arabia 432.
Distillate fuel oil ---do---	3,009	4,579	Saudi Arabia 1,270; Bahrain 1,090; Iran 1,020.
Residual fuel oil ---do---	20,110	22,371	Saudi Arabia 8,028; Iran 7,590.
Lubricants ---do---	129	666	Netherlands Antilles 184; New Zealand 148; Malaysia 121.
Mineral jelly and wax ---do---	59	8	People's Republic of China 4; United States 2.
Other:			
Nonlubricating oils, n.e.s ---do---	32	20	Malaysia 6; United States 4; France 2.
Pitch and petroleum coke ---do---	17	13	Mainly from United States.
Bitumen and bituminous mixtures, n.e.s ---do---	32	26	United States 14; Malaysia 7.
Unspecified ---do---	1,755	2,874	Malaysia 1,915; Iran 378.
Total ---do---	30,746	36,038	
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	327,615	5,955	Taiwan 2,530; Japan 1,370; Australia 1,211.

r Revised. NA Not available.
1 Scrap, if any, is included under "Other scrap, nonferrous."
2 Less than ½ unit.
3 Totals exclude quantity valued at $287,126.
4 Listed under individual metals.
5 Totals exclude bricks of baked clay valued at $943,914 in 1974 and $957,268 in 1975.
6 In addition to the products listed, liquefied petroleum gas valued at $255,194 in 1974 and $235,957 in 1975 was imported.

COMMODITY REVIEW

Metals.—*Iron and Steel.*—Singapore's steel imports were about 1 million tons in 1976, 1.2 million tons in 1975, and 1.4 million tons in 1974, with Japan by far the leading supplier. About two-thirds of the steel imports from Japan consisted of shapes, plates, pipe, and tubing. The steel ingot produced locally, which amounts to about 200,000 tons annually, is derived from scrap. The ingot along with imported materials is then made mainly into rolled semimanufactures.

Reportedly, there were 14 small iron and steel establishments in 1976, employing about 1,400 workers. Only two steel producers were of consequence, National Iron and Steel Mills Ltd. (NISM) and Malayan Iron & Steel Mills Ltd. NISM's plant at Jurong has electric furnaces, merchant bar mills, and a wire rod mill which together turn out more than 200,000 tons of steel products annually. Malayan Mills' facilities are considerably smaller than those of NISM. NISM and Japan's Mitsui & Co., Ltd., have a joint venture called Eastern Wire Manufacturing Co.

Nonmetals.—*Cement.*—Singapore had six cement and cement additive establishments in 1976, employing about 620 workers and realizing $22.8 million in value added from an output of $69.6 million and an input of $46.8 million.[23] Virtually all are grinding operations, relying on imports of clinker. In 1976, Singapore's imports of such clinker were 1,579,758 tons; 1,133,931 tons came from Japan and 354,000 tons from the Republic of Korea and Taiwan combined. In 1975, 1,318,575 tons was imported; 682,866 tons came from Japan and 344,492 tons from the Republic of Korea. Output of finished cement corresponded closely to the amount of clinker imported. Singapore's imports of finished cement were only about 70,000 tons in 1975 and 20,000 tons in 1976. The value of construction averaged about $430 million annually during 1974–76, which represented about 6% of the GNP. One of the large construction jobs in progress was the new Changi airport.

Three older cement plants can be identified—Asia Cement (Singapore) Pte.

[23] Page 19 of work cited in footnote 22.

Ltd.'s 420,000-ton-per-year plant at Jurong, Singapore Cement Manufacturing Co. (Pte.) Ltd.'s 320,000-ton-per-year plant (location unknown), and Pan Malaysia Cement Works Ltd.'s 260,000-ton-per-year plant at Jurong. Ssangyong Cement Industrial Co. Ltd. of the Republic of Korea purchased a $32 million, 600,000-ton-per-year clinker grinding system from Fuller Company for its joint-venture plant in Singapore.[24] This pollution-free plant with a 4,000-horsepower finish grinding mill and in-plant dust collectors started operations during late 1976. Ssangyong's partners included the Development Bank of Singapore and Afro-Asian Shipping Co. Pte., Ltd., both headquartered in Singapore.

Mineral Fuels.—*Petroleum.*—Singapore's program to sharply expand oil refining capacity to a level of about 1 million barrels per day of throughput was completed in 1976. Only Rotterdam, Netherlands, and Houston, Tex., have larger petroleum refining complexes than Singapore. Shell Eastern Petroleum Ltd. completed expansion of its refinery on Pulau Bukom Island to 550,000 barrels per day, making this operation the world's second largest single refinery after another of Shell's refineries at Rotterdam. Esso Singapore Pte. Ltd. completed expansion of its refinery at Pulau Ayer Chawan to 230,000 barrels per day in 1976. Mobil Oil Singapore Pte. Ltd. had completed a 180,000-barrel-per-day refinery at the Jurong Industrial Estate and was planning a $23 million project to boost gasoline production. Singapore Petroleum Co. Pte. Ltd. and BP Refinery Singapore Pte., Ltd., operated two smaller refineries. The sharp increase in oil prices and the subsequent worldwide recession had cut down severely on the demand for Singapore's fuel oil. At year-end, the country's refineries were embarking upon a program to redesign facilities to enable them to handle lighter crude oil and produce more distillates such as automotive diesel oil and kerosine. Singapore's refineries had been designed for the high-sulfur crudes of the Middle East, and some redesigning was contemplated in this area also.

Many international oil companies working in Southeast Asia have established headquarters in this small country. Singapore has become an oil logistics center in the Pacific, with various kinds of seafaring oil exploration and development barges and equipment being built, assembled, and serviced here. Thus, slackening of oil exploration in Indonesia during 1976 affected Singapore's economy adversely. Shipping activity was so heavy that the Singapore Parliament had cause to deliberate a Civil Liability (Oil Pollution) Act recently. A floating oil storage terminal had been built by a consortium of U.S. firms not long ago. Another dimension to Singapore's oil enterprise was the expected construction by Sumitomo of the long-delayed $850 million petrochemical (mainly ethylene) complex on Pulau Ayer Merbau.[25]

SRI LANKA [26]

The agriculturally based Sri Lankan economy was adversely affected by severe drought in the 1975 and 1976 growing seasons. The 3.6% real growth in the GNP in 1975 slipped to about 3.0% for 1976 when the GNP reached $2.86 billion.[27] The return of normal rainfall toward yearend 1976 led to prospects of greatly expanded agricultural output in 1977. A real increase of about 4% in the GNP was predicted for 1977.

The balance-of-trade deficit improved from nearly $202 million in 1975 to $84 million in 1976. In local currency, exports were about the same in 1975 and 1976, whereas imports declined about 15%. In 1976, exports amounted to $588 million and imports to $642 million.

The Government's budgetary position deteriorated during 1976, with increased expenditures causing a record high deficit of $424 million. This deficit amounted to 38% of total expenditures and nearly 15% of the GNP. It is difficult to gage true inflation rates for Sri Lanka because of the

[24] Rock Products (Chicago). April 1977, p. 94.
[25] Far Eastern Economic Review (Hong Kong). Major Plant a Step Closer. Apr. 15, 1977, pp. 36–37.
[26] Prepared by Gordon L. Kinney.
[27] Where necessary, values have been converted from Sri Lankan rupees (Cey Rs) to U.S. dollars at the rate of Cey Rs7.05=US$1.00 in 1975 and Cey Rs8.43=U.S.$1.00 in 1976.

Government's weekly free rice distribution and widespread subsidized services. The actual inflation rate in 1976 has been variously estimated at between 10% and 30%. The 20% unemployment rate continued to be a major problem despite Governmental programs to create jobs. A Central Bank survey in 1975 indicated that almost 1 million people were unemployed, and the 1976 figure was apparently higher.[28]

One of the major growth areas in the economy was the mineral sector, which contributed about one-third of the real increase in the GNP during 1976. Mineral output value was about $62 million for the year, or a little over 2% of the GNP.

Sri Lanka has been known for its precious and semiprecious gems since ancient times. The value of gems produced rose sharply in 1976, registering $39 million. Measured in current rupees, the increase was about 50% over that of 1975. Gems accounted for 65% of Sri Lanka's reported 1976 mineral production value. Virtually all of the country's gems are exported. In the past, most of the gems were smuggled out of the country with no benefit to the Government. Of late, the Government offered various tax and financial inducements to private dealers to use the State Gem Corp. for exporting gems legally, and these actions have significantly lessened smuggling activities.

Cement was a strong second in output value for 1976, accounting for $18 million or 30% of the total. Over 425,000 tons of finished cement was produced in 1976 from the Kankesanturai and Puttalam cement plants and the Galle clinker grinding plant.

Graphite has long been one of Sri Lanka's major mineral products and the second ranking mineral export. Production from the two active mines—Bogala in Kegalla District and Kahatagaha-Kolongalla[29] in Kurunegala District—totaled 8,290 tons in 1976, a more than 30% decrease from that of 1975. Exports increased to over 8,000 tons valued at $2 million. Japan, the United States, and the United Kingdom received the major share of the exports. The Bogala mine accounted for about 60% of the total production and has been credited with having proved reserves of 52,000 tons. At the current rate of production, Bogala's reserves and resources would last for about 10 years.

Two new mines were under development—Rangala in Kegalla District and Ragedara in Kurunegala District. Commercial production was expected to begin at Rangala in 1979; Ragedara will require several additional years to start production. Each mine is designed to produce 1,200 tons per year of graphite when in full operation.

Combined production of all of the lesser minerals was worth only $5 million in 1976. China clay, feldspar, mica, quartz, and salt showed significant gains. Ball clay, limestone, ilmenite, monazite, rutile, and zircon outputs all declined from those of 1975.

Reduced output of ilmenite, rutile, and zircon was a temporary condition. Ceylon Mineral Sands Corp. was constructing an integrated concentrating complex at Pulmoddai with a capacity to process 200,000 tons per year of raw sand. The Pulmoddai deposit reportedly contained 4 million tons of beach sand assaying 70% to 72% ilmenite, 8% to 10% zircon, 8% rutile, 0.3% monazite, and 1% sillimanite. There was no titanium-based industry in Sri Lanka to utilize the ilmenite or rutile, but the Government was undertaking a feasibility study on its establishment.

Geophysical prospecting and core drilling continued during the year at an iron ore deposit located at Seruvilla in Trincomalee District. In addition to the iron, sulfide mineralization analyzing 1% to 3% copper was confirmed. Thus, drilling was continuing to ascertain the tonnages of both the magnetite and sulfide ores. The presence of sulfide mineralization could complicate development of the deposit for iron ore, even if the ore bodies explored should prove to be of commercial size and grade.

Construction of an apatite crushing plant at Eppawala began during the year, where reserves have been reported at 25 million tons of phosphate rock averaging 33% P_2O_5. Geological investigation of a serpentine deposit continued in the Udawalawa area in the southeastern part of the island. The Government was interested

[28] U.S. Embassy, Colombo, Sri Lanka. State Department Airgram A-65, Sept. 13, 1977, pp. 1-10.

[29] The Kahatagaha and Kolongalla mines were linked up underground and operated as a single unit following nationalization of the graphite industry in 1971.

in the serpentine because of the possibility of using it in conjunction with the Eppawala phosphate rock for production of fused magnesium phosphate fertilizer. Since 1973, small amounts of apatite have been ground locally for direct application to crops like tea, rubber, and coconut.

Marathon Petroleum Sri Lanka, Ltd., spudded the first offshore oil exploration well in Sri Lanka's waters in June 1976. The 2,400-meter well, which turned out to be dry, was in a State-held block in Palk Bay north of Mannar Island. Marathon drilled a second well in September at a new site about 40 kilometers north of the first well and on a separate geologic structure. It also turned out to be a dry hole and as a result, Marathon reportedly decided to withdraw from its production-sharing contract covering a 7,000-square-kilometer concession area. No other firms drilled offshore Sri Lanka during 1976.

The country continued to depend totally on foreign crude oil for its needs. Imports in 1976 were nearly 1.5 million tons valued at $129 million. Saudi Arabia and Iran supplied the crude oil for refining at the Sapugaskanda refinery. Construction began on the country's first urea fertilizer plant in 1976. The 300,000-ton-per-year plant, to be located at Sapugaskanda, is designed to use naphtha feedstock from the adjacent refinery. Also in conjunction with the refinery, the country expects to build its first nylon plant. A contract was signed in late December with Japanese firms for the construction of the more than $30 million plant.

VIETNAM [30]

On April 25, 1976, general elections were held in the north and the south to choose a common national assembly. On July 2, 1976, the newly elected assembly, meeting in Hanoi, declared the formal reunification of the country, officially designated as the Socialist Republic of Vietnam, with Hanoi as the capital city. Old administrative divisions were revised and the number of provinces was revised to 35. There were 249 deputies elected from the northern provinces and 243 deputies elected to represent the southern provinces.

The value of exports from Vietnam reportedly totaled $227 million in 1976, up about 6% from that of the previous year, while the value of imports at about $831 million was down about 29% from the 1975 level.[31] The trade deficit in 1976 was about $604 million. Although conditions in 1976 cannot be compared with those in previous years owing to the different economic systems, it was apparent that Hanoi succeeded in reducing the 1975 trade deficit probably by more than one-third.[32]

The second 5-year plan (1976–80) was finally approved at the end of 1976, making it effectively a 4-year plan. The plan seeks to increase the GNP 18% in 1977. Other targets include a 20% growth in the industrial sector and a 16% increase in the dominant agricultural sector by 1977. Emphasis swung away from the heavy industry sector to the agriculture industry, light industry, and sectors that would support agriculture, especially electrical power and the road network.

Although agricultural output reportedly increased about 20% in 1976, it was still not sufficient to meet the country's needs. A United Nations report estimated a food deficit of 1.2 million tons of rice and 150,000 tons of wheat during 1976. Hanoi was forced to buy food from Burma and the U.S.S.R. and also foodstuffs valued at $35 million from the United Nations World Food Program. Poor growing conditions, drought, and floods combined to reduce expected gains in 1976. Agricultural improvement programs were pursued throughout the country during the year. Old canals were repaired and dredged and 16 large irrigation projects were started in the south. Fallow land was reclaimed and 500,000 hectares of Mekong delta land was reportedly put under double cropping.

Reconstruction and expansion of the electrical power network continued as rapidly as equipment became available. Much of the improvement in electrification was directly associated with the drive to increase agricultural output. About two-thirds of the electricity generated in the north was produced in plants fueled by north Vietnamese coal. The total capacity

[30] Prepared by Gordon L. Kinney.
[31] Trade with the People's Republic of China is not included in these figures.
[32] Asian Wall Street Journal. V. 2, No. 22, Sept. 30, 1977, p. 3.

of irrigation pumping stations powered by electricity was reported at 219 megawatts at yearend 1976. Additional power was consumed by electric pumps used to aid in dewatering more than 86,000 hectares of cropland. Over 5,000 kilometers of electrical power distribution lines were directly serving agricultural purposes. Electrical power for agricultural enterprises increased nearly 50% over the 1975 supply, whereas total national output of electricity rose only 20%.

Other electrical power developments included restoration of the Da Nhim hydroelectric plant near Da Lát and its high-voltage powerline network. The plant supplies electricity to the Ho Chi Minh City (Saigon) grid and to Nha Trang. Capacity of the Ninh Bình thermal powerplant in Ha Nam Province was reportedly increased to 100 megawatts. Initial construction began in 1971, but this plant was damaged during interim hostilities. The Uong Bi thermal powerplant and distribution lines were under priority reconstruction and expansion; its capacity at yearend 1976 was 98 megawatts.

Geological and engineering studies for the 1,664-megawatt Da River hydroelectric project near Hoa Binh were nearly completed and preparatory work prior to construction had begun. When completed, this would be the largest hydroelectric station in Southeast Asia. The U.S.S.R. was providing economic and technical assistance for the project which could be completed in a decade.

Vietnam's largest single reconstruction project of 1976, involving 70,000 workers, was completed in December when trains began running between Hanoi and Ho Chi Minh City. This marked the reopening of the entire 1,730-kilometer coastal railroad, which was virtually destroyed by years of military action. The Government publicized the event as a tangible example of the reunification of the north and south. In addition, 80 kilometers of track was rebuilt from Kep to Uong Bi in Quang Ninh Province to transport coal to the thermal powerplant at Uong Bi.

Vietnam has not been a major world producer of any mineral products, although output of anthracite, apatite, and cement is of some consequence. Data on production are difficult to obtain and seldom specific. The available figures are often stated in terms of percentage increase over an unstated or unknown base period. The more important minerals exploited in 1976 were coal, tin, chromite, iron, apatite, and zinc. Small amounts of gypsum, salt, antimony, gold, copper, limestone, clay, and glass sand were also produced. Cement and brick were both produced from local raw materials.

COMMODITY REVIEW

Metals.—*Antimony.*—Local antimony ore was refined at a new processing plant, completed in April 1976, in the north. The plant appeared to be the first of its kind in the country.

Chromite.—The only known production of chromite occurred at Co Dinh in Thanh Hoa Province. No details are available on the operation, although production reportedly exceeded the 1976 target. About 8,000 tons of ore was said to have been mined during the first 11 months of 1976.

Iron and Steel.—Iron ore apparently was mined at 11 locations in Vietnam during 1976. The Trai Cau mine was the principal iron mine supplying the nearby Nyuyen steelworks. Rated at 200,000 tons annually of finished steel plates and rods and producing roughly this tonnage in 1976, the Nyuyen iron and steel complex was scheduled to be expanded about 50% by 1980. Three furnaces of the Nyuyen complex were reportedly repaired with Chinese technical aid, and a 20,000-ton-per-year coke plant was apparently working satisfactorily. The Gia Sang and Luu Xa rolling mills were units of the Nyuyen complex. The Gia Sang mill was completed in 1975 with East German aid, and the new 120,000-ton-per-year Luu Xa mill located about 5 kilometers from Gia Sang was not yet fully built by yearend 1976. A 50-meter-high dam was under construction at Nui Coc to supply water to the steel complex and surrounding area.

The Government was planning a new 460,000-ton integrated steelmill which would include a small blast furnace, two 30-ton converters, a continuous casting mill, a bar mill, and an angle rolling mill. Japan, the People's Republic of China, the U.S.S.R., and France were interested in supplying components to the project. Since recent emphasis was on agricultural production rather than heavy industry, im-

plementation of these plans may well be delayed.

Vietnam did not produce enough steel to satisfy its needs, necessitating imports from various sources, primarily the U.S.S.R. and Japan, and secondarily the Netherlands, Sweden, and Eastern Europe. The People's Republic of China may also have furnished small tonnages of unfinished steels.

Other.—Tin was mined at Cao Bang and reportedly also at Vinh and Viet Tri. The Government was planning to increase tin output during the current 5-year plan. Estimated production of tin-in-concentrate was 300 tons in 1976. Approximately 80 tons of tin metal was exported to the U.S.S.R. in 1976.

Zinc ore, produced at the Cho Dien mine, was refined at a small smelter (with perhaps a 10,000-ton-per-year capacity) at Quang Yen.

Nonmetals.—*Brick.*—Vietnam uses domestic clay deposits to produce its own brick and tile for its growing construction needs. Efforts were being made to increase production throughout the country. Two new 20-million-brick-per-year kilns were completed during 1976. In addition, at least four new kilns of unknown capacity were completed, and twelve were scheduled for completion in 1977. Production was reported at 2,400 million brick in 1976, compared with 1,700 million brick in 1975, a 41% increase. Planned output for 1977 was 3,200 million brick. The overall value of building materials produced in 1976 reportedly rose 64% over that of 1975.

Cement.—Vietnam produced about 730,000 tons of cement during 1976 and planned a 13% increase in the 1977 output. There were two plants with 300,000-ton-per-year rotary kilns operating in 1976. One was at Haiphong and the other was at Hà Tiên in the extreme southwestern corner of the country. Additionally, several small plants supply local needs.

The second 5-year plan, ending in 1980, envisaged increasing Vietnamese cement output to 2 million tons. The U.S.S.R. was to furnish aid in constructing plants at Binh Son and Thanh Hoa, and the People's Republic of China was scheduled to help build another at Phu Ly near Hanoi. However, the only project known to be underway was a 1-million-ton-per-year plant at Hoang Thach (21°02′ N, 106°35′ E), being built jointly by companies from Japan and Denmark for over $66 million. The contract was signed in late 1976, and the plant was due to be completed in 1978.

Fertilizer Materials.—Production of chemical fertilizers continued to have a high priority, to support the drive for higher agricultural yields. No clear breakdown of production by type was officially reported, although some fragmentary data were available. The Lam Thao superphosphate plant turned out 170,000 tons during 1976, despite problems with its supply of pyrite. The capacity of the plant was rated at 200,000 tons per year.

An apatite mine at Lao Cai has long been the principal producer of crude phosphate in Vietnam. Annual output of Lao Cai presumably has been over 1 million tons; much of this is exported to the People's Republic of China and elsewhere. Domestic markets include the Lam Thao plant, the newly reopened Hai Hung apatite grinding works, and a new phosphate works at Van Dien. A grinding section was being added to the Lao Cai mine in 1976, under a priority expansion program.

The status in 1976 of the Ha Bac nitrogenous fertilizer plant at Bac Giang was uncertain. The plant, built in 1965 with Chinese aid, was subsequently damaged during the hostilities. Reconstruction and expansion of the plant began in June 1973, and equipment testing and trial production reportedly began in August 1976.

Lime.—The second 5-year plan called for a large increase in lime production, especially for use in fertilizer manufacture. The tonnage of lime produced in 1976 may be between 1.4 million and 1.7 million tons. At least two new lime kilns were completed during 1976; the largest may have a capacity of 20,000 tons per year. A goal of 2 million tons was set for 1978 with 1.6 million tons going to the agricultural sector. Most of the lime was produced in the north, causing supply problems for the heavily agricultural southern provinces. Reopening of the railroad to Ho Chi Minh City, however, should facilitate moving the lime to the south.

Mineral Fuels.—*Coal.*—The Government was trying to increase coal production as rapidly as finances and available equipment would allow. During 1976, a goal of 10 million tons was set for 1980;

all phases of development, production, and distribution were simultaneously emphasized so as to achieve the 1980 target.

Gross coal production for 1976 was reported by the Government to be 1.6 times the 1965 level. The Vietnamese claimed that the 1975 target of 5.3 million tons of coal was surpassed, and that output in 1976 had risen about 10%. A target of 6 million tons was set for 1977. The Vietnamese reported in 1976 that overburden removal at open pit coal operations was to be increased 29% in 1977. This stripping rate would significantly increase the output from several existing mines within the next few years.

The heart of the Vietnamese coal industry was still the Hon Gai anthracite combine with open pit mines called Deo Nai, Ha Lam, Cao Son, and Ha Tu, as well as underground operations, to tap reserves of several billion tons. The Hon Gai Colliery Design Institute reportedly had completed blueprints for 18 projects, including 9 coal pits, 2 coal ports, various coal beneficiation and transportation facities, and small coal mines.[33] Apparently the Cao Son mine was being expanded with Soviet aid to more than 2 million tons annually. A Japanese company was helping to build a coal calcining plant for Hon Gai. A new 600,000-ton-per-year coal combine called Mao Khe in Quang Ninh Province was also in the process of substantial expansion. Bac Thai was mentioned as a new mining area that might be supplying coking coal for iron and steel manufacture. Vietnamese engineers designed a new 350,000-ton-per-year colliery at Khe Chan (probably at 21°05′ N, 107°05′ E) in Quang Ninh Province, scheduled to start construction in 1977.

Part of Vietnam's anthracite is exported; in 1976, about 700,000 tons went to Japan alone. The Japanese were bargaining for a doubling of supply in 1977, but actual shipments probably will be under 1 million tons.

Petroleum and Natural Gas.—No petroleum or natural gas was produced in Vietnam in 1976. Offshore oil strikes of possible commercial value were made by a Shell-Cities Service consortium in 1974 and by the Mobil group in February 1975. Interest in renewing exploration was therefore high on the part of both the Government's Oil and Natural Gas Commission and several foreign oil companies. The Government did not have the expertise to continue exploration, but Vietnamese officials were also hesitant about signing production-sharing agreements with profit-oriented foreign firms. The year was mostly spent by the Government in negotiating, visiting, and learning, while the groundwork was being laid for resuming exploration under Vietnamese terms.

However, there were some tangible accomplishments. The French Compagnie Générale de Geophysique (CGG) working under contract to the Vietnamese Government began exploration survey work off the southern coast of Vietnam in March 1976. The French Compagnie Maritime d'Expertises (COMEX) reportedly signed an agreement to develop the port of Vung Tau into a major offshore oil development support base. Norwegian interests reportedly won the first new drilling rights with a contract to drill six exploration wells off the southern coast. Negotiations by several countries and companies were continuing at yearend.

[33] World Coal (San Francisco). August 1977, pp. 8–9.

The Mineral Industry of Other Countries of the Near East

By Staff, Bureau of Mines

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AFGHANISTAN [1]

The mineral industry of Afghanistan improved substantially in 1976 as asbestos production was begun and feasibility studies were made of possible copper and iron and steel industries. The remarkable event of the year was the introduction of Afghanistan's 7-year economic and social development plan which covered the years 1976–82. The 7-year plan established ambitious goals for a gross national product (GNP) annual growth rate of 6.3% during its duration. To achieve this target, large increases in expenditures for economic development were programed in virtually every sector of the economy. Foreign assistance, in particular, was expected to finance a large share of new development projects.

The major components of the plan were the development of transportation (highways and railroads), oil and gas exploration, construction of a copper smelter to exploit the copper deposits near Kābul, and development of an iron and steel industry to exploit the rich iron ore deposits in the central part of the country. Exports during the plan period were to continue to be principally agriculture products and natural gas to the U.S.S.R.

The 7-year plan briefly outlined the role of the private sector in the development of the economy. The plan foresaw a mixed and guided economy, with those industries requiring small investment and simple technology left to the private sector and large key industries owned and operated by the public sector. The plan stated that a list of industrial activities was to be prepared in which the participation of domestic and foreign investors would be outlined. The Afghan investment law in 1976 limited foreign ownership of industries to 49%.

Tricentrol International Ltd., the United Kingdom-owned oil, gas, and minerals company, was granted prospecting rights by the Afghan Government to look for hydrocarbon possibilities in a 33,000-square-kilometer area of northwestern Afghanistan. Tricentrol was to submit its reports to the country's National Oil Institute by mid-1977.

Natural gas maintained its position as Afghanistan's most important export commodity in 1976. Total production of 3 billion cubic meters was reported for the year, of which 2.5 billion cubic meters was exported to the U.S.S.R. as part of an agreement signed in 1975 and the re-

[1] Prepared by E. Shekarchi, supervisory physical scientist, International Data and Analysis.

mainder was used in domestic power production. Export earnings from natural gas were approximately $45 million.[2] Production of coal and talc increased 2% and 50%, respectively. Hydraulic cement production increased 19% in 1976. Afghanistan's Ministry of Mines and Industries awarded a $50 million contract to a U.S. consortium consisting of Fuller Company (Pa.), Fischbach & Moore, Inc. (Tex.), and Oman Construction Co. Inc. (Tenn.). The contract called for construction of a 1,600-ton-per-day cement plant in the Kandahār region. The unique turnkey project was to include geological and techno-economic studies, supply of all equipment, erection, installation, civil works, and initial training. Upon completion of the plant, scheduled for the second quarter of 1979, a Fuller startup team was to assist in running the plant while training Afghan personnel. It was estimated that as many as 600 new jobs would be created during the construction period alone. The completed plant will provide many quarrying, operation, and management jobs.

Barite production in 1976 remained at the same level as in 1975. The Sanglau barite mine was again the primary source while the Farinjal deposit remained dormant, owing to transportation problems. A total of 13,000 tons of asbestos production was reported for the first time from Afghanistan. The details of mine location, type of asbestos, and reserves were not available by yearend.

[2] Where necessary, values have been converted from Afghanis (Af) to U.S. dollars at the rate of Af45 = US$1.00.

Table 1.—Other Countries of the Near East: Production of mineral commodities

Area, commodity, and unit of measure	1974	1975	1976 p
AFGHANISTAN [1 2]			
Asbestos ---------- thousand metric tons	NA	NA	13
Barite ---------- do	10	5	5
Cement, hydraulic ---------- do	146	140	e 167
Coal, bituminous ---------- do	153	160	164
Gas, natural:			
Gross production ---------- million cubic feet	113,006	105,944	e 96,000
Marketed production ---------- do	r 113,006	98,881	89,805
Gem stones: Lapis lazuli ---------- kilograms	8,500	8,000	7,406
Natural gas liquids e ---------- thousand 42-gallon barrels	15	15	9
Salt, rock ---------- thousand metric tons	51	60	70
Talc ---------- do	3	6	9
BAHRAIN [1]			
Aluminum, primary smelter ---------- metric tons	118,000	116,300	122,100
Gas, natural:			
Gross production ---------- million cubic feet	100,010	101,546	107,464
Marketed production [3] ---------- do	68,255	73,343	76,931
Petroleum:			
Crude ---------- thousand 42-gallon barrels	24,597	20,805	21,288
Refinery products:			
Gasoline ---------- do	9,742	9,667	9,520
Jet fuel ---------- do	8,658	8,842	8,833
Kerosine ---------- do	2,334	2,939	5,361
Distillate fuel oil ---------- do	19,001	20,733	19,475
Residual fuel oil ---------- do	37,877	28,052	26,476
Lubricants ---------- do	666	--	--
Other ---------- do	10,449	6,186	9,084
Refinery fuel and losses ---------- do	2,669	2,256	1,257
Total ---------- do	91,396	78,675	80,006
JORDAN			
Cement, hydraulic ---------- thousand metric tons	596	572	533
Clays ---------- do	10	10	12
Fertilizer materials: Crude phosphate rock ---------- do	1,675	1,353	1,768
Gypsum ---------- do	30	30	21
Iron and steel semimanufactures ---------- do	25	31	42
Lime ---------- do	3	3	3
Petroleum refinery products:			
Gasoline ---------- thousand 42-gallon barrels	1,202	1,684	1,729
Jet fuel ---------- do	490	584	834
Kerosine ---------- do	875	899	1,241
Distillate fuel oil ---------- do	1,437	1,673	2,505
Residual fuel oil ---------- do	1,283	969	1,601
Other:			
Liquefied petroleum gas ---------- do	239	296	428
Asphalt ---------- do	239	222	385
Unspecified ---------- do	1,032	--	4
Refinery fuel and losses ---------- do	453	332	516
Total ---------- do	7,250	6,659	9,243
Salt ---------- do	15	16	20
Stone:			
Limestone ---------- do	3,000	3,500	5,000
Marble ---------- thousand square meters	100	1,150	150

See footnotes at end of table.

Table 1.—Other Countries of the Near East: Production of mineral commodities —Continued

Area, commodity, and unit of measure	1974	1975	1976 p
LEBANON [1]			
Cement, hydraulic ---thousand metric tons--	1,744	1,649	e 1,700
Gypsum ---do----	13	e 13	e 13
Iron and steel semimanufactures e ---do----	350	350	350
Lime ---do----	177	e 180	e 180
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels--	4,904	4,062	1,530
Jet fuel ---do----	1,663	1,297	640
Kerosine ---do----	172	205	78
Distillate fuel oil ---do----	3,179	3,234	1,492
Residual fuel oil ---do----	6,079	4,833	2,198
Other:			
Liquefied petroleum gas ---do----	875	{462	290
Unspecified ---do----		{151	--
Refinery fuel and losses ---do----	849	949	--
Total ---do----	17,721	15,193	6,228
Salt e ---thousand metric tons--	35	35	35
OMAN			
Gas, natural:			
Gross production ---million cubic feet--	r e 36,000	r e 42,000	45,000
Marketed production ---do----	1,500	1,700	2,000
Petroleum, crude ---thousand 42-gallon barrels--	106,046	124,600	133,795
QATAR [1]			
Cement, hydraulic ---thousand metric tons--	r e 122	164	172
Gas, natural:			
Gross production ---million cubic feet--	181,905	192,005	e 220,000
Marketed production [4] ---do----	45,909	78,010	e 85,000
Petroleum:			
Crude ---thousand 42-gallon barrels--	189,348	159,482	181,644
Refinery products:			
Gasoline ---do----	e 54	550	671
Jet fuel ---do----	--	229	382
Kerosine ---do----	e 30	36	39
Distillate fuel oil ---do----	e 43	519	840
Residual fuel oil ---do----	e 69	17	--
Other ---do----	--	2	46
Refinery fuel and losses ---do----	e 21	99	30
Total ---do----	e 217	1,452	2,008
SYRIA [1]			
Asphalt, natural ---do----	NA	NA	125
Cement, hydraulic ---thousand metric tons--	965	859	994
Fertilizer materials: Crude phosphate rock ---do----	603	857	511
Gas, natural:			
Gross production e ---million cubic feet--	40,000	58,000	61,000
Marketed production ---do----	6,356	7,396	7,800
Gypsum e ---thousand metric tons--	15	15	24
Petroleum:			
Crude ---thousand 42-gallon barrels--	45,352	65,930	69,685
Refinery products:			
Gasoline ---do----	2,406	2,915	3,434
Kerosine and jet fuel ---do----	1,604	2,899	2,920
Distillate fuel oil ---do----	3,857	4,692	5,282
Residual fuel oil ---do----	4,056	5,508	7,273
Other:			
Liquefied petroleum gas ---do----	741	{302	244
Asphalt ---do----		{515	673
Refinery fuel and losses ---do----	1,013	841	1,288
Total ---do----	13,677	17,672	21,114
Salt ---thousand metric tons--	40	33	54
Sand, glass e ---do----	15	15	15
PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN			
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels--	3,767	1,343	845
Jet fuel ---do----	1,928	1,176	1,169
Kerosine ---do----	1,081	760	779
Distillate fuel oil ---do----	4,368	2,268	2,808
Residual fuel oil ---do----	8,135	4,835	6,019
Other ---do----	30	592	765
Refinery fuel and losses ---do----	596	859	772
Total ---do----	19,905	11,833	13,157
Salt e ---thousand metric tons--	75	75	75
YEMEN ARAB REPUBLIC [1]			
Cement ---do----	36	e 50	e 60

e Estimate. p Preliminary. r Revised. NA Not available.

[1] In addition to the commodities listed, crude construction materials such as common clays, stone, and sand and gravel presumably are produced, but output is not recorded quantitatively and general information is inadequate for formulation of estimates of output levels.

[2] Data are for years beginning March 21 of that stated.

[3] Excluding gas used for gas lift.

[4] Includes gas reinjected to reservoirs, if any.

BAHRAIN [3]

During 1976, petroleum and natural gas were the major mineral products of Bahrain, an archipelagic sheikdom in the Persian Gulf between the Qatar peninsula and Saudi Arabia. Bahrain's oil revenue increased from $280 million [4] in 1975 to about $334 million in 1976, owing to increases in both price and production. The petroleum industry continued as the keystone of the Bahraini economy, with receipts from this source accounting for about 73% of total Government revenue during the year. The Awali Field in south-central Bahrain, the main island, produced 21.3 million barrels in 1976 and 20.8 million barrels in 1975, compared with the 25-million-barrel average for peak production years 1972–74. The Abu Safah Field, located in the Persian Gulf north of Bahrain and shared with Saudi Arabia, produced 37 million barrels in 1976, a 68% increase over that of 1975 but well below the 44 million barrels of 1974.

Although oil exploration continued both onshore and in the Persian Gulf, no new discoveries were made during the year. Bahrain remained an important oil refining center and processed about 58.8 million barrels of Saudi crude in addition to all production from the Awali Field. Throughput at the 250,000-barrel-per-day Awali refinery averaged 219,200 barrels per day in 1976, a 2% increase over the 215,500 barrels per day processed in 1975.

The Bahrain Petroleum Co., Ltd. (BAPCO), a subsidiary of the California Texas Petroleum Corp. (Caltex), had controlled the petroleum industry in Bahrain since the 1930's. In 1974, BAPCO and the Government reached an agreement by which the Government acquired 60% ownership of BAPCO's oil and gas production facilities. The Government announced its intentions to eventually achieve 100% participation and in 1976 established the Bahrain National Oil Co. (BANOCO) to administer its share of BAPCO and to manage domestic marketing of petroleum products. Caltex retained full ownership of the Awali petroleum refinery. The Abu Safah oilfield was administered by the Arabian American Oil Co. (Aramco) and revenues from the Field were shared equally by the Governments of Bahrain and Saudi Arabia.

The production of natural gas, controlled by BAPCO, increased 6.0%, from 7.87 million cubic meters per day in 1975 to 8.34 million cubic meters per day during 1976. Bahrain's natural gas reserves in the Khuff and Arab zones were estimated at 270,000 million cubic meters. About 38% of the natural gas production was used to fuel the country's aluminum smelter, 28% was used to maintain pressure in the Awali oilfield, 21% was consumed by the producer, and 13% was used for the commercial production of electricity.

Without any new oil discoveries since 1963, and faced with oil depletion in 15 to 20 years, Bahrain was attempting to diversify its economic base. The Sitra 120,000-ton-per-year aluminum smelter that commenced operations in 1971 continued as a successful venture and was owned 77.9% by the Government, 17% by Kaiser Aluminum & Chemical Corp., and 5.1% by Breton Investments. Aluminium Bahrain Ltd. (ALBA) operated the smelter above rated capacity and produced approximately 122,100 tons of aluminum metal in 1976, 5,800 tons more than the 1975 output. The aluminum smelter received alumina feedstock from Australia and exported aluminum ingot to Japan, the People's Republic of China, Iraq, Brazil, and Argentina. A Government-owned aluminum extrusion plant, the first on the Persian Gulf, was nearing completion near the ALBA smelter during 1976. The $12 million, 3,000-ton-per-year plant was to come onstream in 1977. It was designed by Swiss Aluminium Ltd. (Alusuisse) and was equipped with a 2,000-ton Schloemann Siemag AG press from West Germany, Tanner Companies anodizing facilities from the United States, and extrusion dies manufactured in the United Kingdom. Vereinigte Aluminium Werke (VAW) of West Germany was studying the feasibility of an aluminum rolling mill in Bahrain that would use rolling slab from the ALBA smelter.

Construction of a major dry dock and shipyard facility at the southeastern end

[3] Prepared by David E. Morse, physical scientist, International Data and Analysis.

[4] Where necessary, values have been converted from Bahrain dinars (BD) to U.S. dollars at the rate of BD1=US$2.551.

of Muharraq Island was in full swing during 1976. The $200 million venture, known as the Arab Shipbuilding and Repair Yard, was sponsored by the Organization of Arab Petroleum Exporting Countries (OAPEC) and was to be in operation by 1978. The single dry dock was to be capable of accommodating vessels of up to 500,000 deadweight tons and was of prime importance to the OAPEC-sponsored tanker fleet of the Arab Maritime Petroleum Transport Co.

Bahrain and Saudi Arabia planned to build a cement plant in eastern Saudi Arabia. The 6,000-ton-per-day facility would be financed 75% by Saudi Arabia and 25% by Bahrain, and its output would satisfy Bahrain's cement needs and part of Saudi Arabia's.

Improvements were scheduled to relieve congestion at port and transport facilities at Mina Sulman, Bahrain's only major port. In June 1976, a contract was awarded to three French companies to build six new deepwater berths, transient sheds, and open storage areas at Mina Sulman. The handling capacity of the port was to be increased 30% and storage areas would be doubled with the completion of the expansion work scheduled for 1979. During 1976, as in previous years, about one-third of the goods traversing the docks at Mina Sulman were destined for other Persian Gulf States, principally Saudi Arabia. A causeway linking Bahrain and the Saudi mainland was to be built with Saudi financing at a cost of $250 million.

Table 2.—Bahrain: Foreign trade in crude petroleum and petroleum refinery products

(Thousand 42-gallon barrels)

Commodity	1974	1975	1976
EXPORTS			
Crude petroleum	2,831	--	--
Petroleum refinery products:			
Gasoline	9,366	8,996	8,753
Jet fuel	7,674	7,148	8,064
Kerosine	2,320	2,922	5,236
Distillate fuel oil	663	18,723	18,993
Residual fuel oil	37,152	26,730	26,976
Lubricants	--	--	--
Other, including naphtha	10,373	--	9,348
Total	67,548	64,519	77,370
BUNKER LOADINGS			
Petroleum refinery products:			
Distillate fuel oil	NA	836	NA
Residual fuel oil	NA	3,443	NA
Total	NA	4,279	NA
IMPORTS			
Crude petroleum	64,521	55,423	77,102
Petroleum refinery products:			
Kerosine	--	--	7
Lubricants	3	5	78
Petroleum coke	--	--	564
Total	3	5	649

NA Not available.

JORDAN [5]

The mineral sector contributed approximately 15% to Jordan's GNP of $1.5 billion [6] in 1976. Phosphate mining and cement production were the country's only major industries based on local mineral deposits. Other mineral production was confined to refining of imported crude oil and mining of small amounts of gypsum, clay, lime, marble, and salt. Production of mineral commodities in Jordan in 1976 is reported in table 1.

Jordan's ambitious 5-year plan (1976–80) scheduled a total expenditure of $2.4 billion, of which 25% was allocated to the

[5] Prepared by Candice Stevens, economist, International Data and Analysis.

[6] Where necessary, values have been converted from Jordan dinars (JD) to U.S. dollars at the rate of JD0.332=US$1.00.

industrial and mining sector. Approximately $270 million was to be expended on expansion of phosphate operations and development of a domestic fertilizer industry. Other projects included the production of potash from the Dead Sea, construction of additional cement plants, and expansion of the Zarqa oil refinery. Potential commercial deposits of copper, manganese, uranium, and vanadium were to be further explored and studied.

The country's chronic trade deficit increased to $816 million as imports continued to outweigh exports. Phosphate was Jordan's most important export accounting for 39% of total export earnings. As in past years, budget support from other Arab countries and the United States, in addition to large remittances from Jordanians working abroad, contributed to an overall balance of payments surplus. Foreign aid from Arab States totaled $230 million in 1976. During the year, Jordan and Syria initiated several economic and technical cooperation projects, including the coordination of development plans and the granting of mutual tariff and customs exemptions. Among the joint organizations created were the Jordanian-Syrian Industrial Co., the Joint Industrial Free Zone Co., and the Jordanian-Syrian Ground Transport Co.

Phosphate production increased from 1.35 million tons in 1975 to a record high of 1.8 million tons in 1976. Exports increased from 1.1 million tons in 1975 to 1.65 million tons in 1976, going to the following destinations: Western Europe (23%), Eastern Europe (39%), Asia (35%), and Africa (3%). Despite increased exports, revenues dropped to about $55 million owing to lower phosphate prices. In November 1976, Jordan entered into an informal association of phosphate producers which sought a means of coordinating exports and promoting higher prices. Under the 5-year plan, phosphate production capacity was to be increased from 2 million tons to 7 million tons per year by 1980. Reserves were estimated at 2.5 billion tons.

Jordan had estimated reserves of 200,000 to 300,000 tons of uranium-associated minerals and nearly 1 million tons of vanadium-associated minerals. Discussions were in progress with foreign firms regarding the separation and processing of the uranium and vanadium ores.

The Jordan Phosphate Mines Co. Ltd., in which the Government held 82% interest, operated two major mining operations. The El Hasa mine, 200 kilometers north of Aqaba, had proven reserves of 200 million tons. Production was to be increased from 1.2 million tons to 2.4 million tons per year from the opencast mine, and a 1.8-million-ton-per-year underground operation was to be developed at that same location. Taylor Woodrow Construction Ltd. (United Kingdom) was contracted for the expansion of the beneficiation plants at El Hasa which produced a 75% tricalcium phosphate (TPL) product. A smaller expansion project was scheduled at Ruseifa, 15 kilometers northeast of Amman, to increase production capacity from 800,000 tons to 1 million tons per year. Excavation began in 1976 on a third mine at Shīdiyah, 130 kilometers northeast of Aqaba. Reserves were estimated at 230 million tons of phosphate at this location.

The Jordan Fertilizer Industry Co., which was to construct a $325 million phosphate fertilizer complex in Aqaba, contracted Spie-Batignolles S.A. (France) as general manager of the project. The complex, to be completed in 1980, was to produce 1,800 tons per day of sulfuric acid, 1,000 tons per day of phosphoric acid, and 2,000 tons per day of monoammonium and diammonium phosphate. In 1976, Agrico Chemical Company (United States) withdrew its 25% interest in the project and negotiations were ongoing for a replacement. Other major shareholders were the Jordanian Government (25%), Jordan Phosphate Mines (25%), and the International Finance Corp. (5%). Discussions were being held with the Petro Chemical Industries Co. (Kuwait) regarding a joint venture for a $30 million ammonium phosphate project in Jordan.

The Arab Potash Co., owned 51% by the Jordanian Government, 40% by the Arab Mining Co., and 9% by other Arab countries, sought financing for its Dead Sea potash project. Jacobs Engineering Co. (United States) continued its feasibility study of the project which was to process carnallite, produced by solar evaporation of Dead Sea brines, to yield 1 million tons per year of potash. Production was to begin in 1981 and increase to 1.2 million

tons per year by 1984 and 10.7 million tons per year by 1990. Reserves of potash in Dead Sea waters were conservatively estimated at 2 billion tons. Total cost of the project, which was to include a 200-kilometer railroad to ship potash to the port of Aqaba, was approximately $425 million. The first stage was to be financed by the Jordanian Government ($3 million), the U.S. Agency for International Development (AID) ($6 million), and the International Bank for Reconstruction and Development (IBRD) ($1 million).

The Jordanian Cement Co., which operated Jordan's only cement plant near Amman, produced 533,000 tons of cement in 1976. Increasing construction requirements in Jordan prompted plans to expand cement capacity. The Amman plant was to double its capacity from 600,000 tons to 1.2 million tons per year. Romania and Jordan were to cooperate on the construction of a 1-million-ton-per-year cement plant near Aqaba. The Jordanian-Syrian Industrial Co. conducted exploration for limestone in southern Jordan as the basis for a joint-venture, 1-million-ton-per-year cement plant.

The Department of Petroleum Affairs was established in 1976 to supervise exploration activities. The Filon Corp. (United States) carried out photogeological and seismic surveys in its 8,000-square-kilometer concession area on the eastern bank of the northern Jordan River. Under its 1975 contract, Filon was to drill at least 15 wells and undertake survey work at an initial cost of $1.6 million. The firm was to bear all exploration and development costs and receive 35% of production revenues in the case of commercial discovery. The only other petroleum exploration was conducted by the U.S.S.R. under a mutual cooperation pact.

The Zarqa refinery, situated 25 kilometers from Amman, produced approximately 8 million barrels of petroleum products in 1976. Less than 500,000 barrels was exported to Lebanon and Syria with the remainder consumed locally. Romania's Industrialexport was awarded a $190 million contract to expand capacity of the refinery from 24,000 barrels to 60,000 barrels per day. Expansions to the refinery, operated by the State-owned Jordan Petroleum Refinery Co., Ltd., were to be completed in 1978. In March 1976, Jordan reached an agreement with the Trans-Arabian Pipe Line Company (TAPline) regarding the price of crude supplies to the Zarqa refinery. Prices were raised from $3.50 to $11.50 per barrel. Saudi Arabia agreed to make up the higher crude oil price for the first 2 years and also agreed to pay Jordan's outstanding debt of $115 million to TAPline. During the year, the prices of petroleum products in Jordan were raised by an average of 20%.

Expansion of the Zarqa refinery was expected to satisfy local demand until 1980. To meet future requirements, Jordan planned a second refinery as a joint venture with Romania. The 60,000-barrel-per-day refinery was to be supplied by crude oil transported by TAPline from Saudi Arabia.

The Jordanian Natural Resources Authority (NRA) renewed the agreement with the Bureau de Recherches Géologiques et Minières (BRGM) of France for copper and manganese prospecting. BRGM estimated reserves of copper in the Wadi 'Araba region at 65 million tons. The French firm Sofremines was conducting a study of appropriate mining techniques for exploitation of the deposits at the rate of 10,000 tons per day. The Wadi 'Araba region also contained proven reserves of 1.5 million tons of manganese ore with estimated reserves of 5 million tons. Details of the grade of copper and manganese ore were not available at yearend.

Table 3.—Jordan: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal destinations, 1975
METALS			
Aluminum, unwrought and semimanufactures	308	282	Mainly to Syria.
Copper, matte	529	163	All to Syria.
Iron and steel:			
Scrap	20,147	1,737	Lebanon 1,017; Syria 594.
Semimanufactures	r 9,185	819	Saudi Arabia 437; Syria 230; Kuwait 120.
Lead metal including alloys, all forms	63	910	Egypt 720; Syria 165.
Zinc metal including alloys, all forms	34	50	Mainly to Syria.
NONMETALS			
Cement	209,181	73,458	Saudi Arabia 60,891; Syria 12,567.
Clays and clay products:			
Crude clays	--	35	All to Lebanon.
Clay products, refractory	324	--	
Fertilizer materials:			
Crude, phosphatic	1,468,958	1,111,877	Turkey 179,629; Romania 175,410; Taiwan 124,870.
Manufactured, nitrogenous	16	45	All to Syria.
Lime	--	145	All to Kuwait.
Salt	748	--	
Stone, sand and gravel:			
Dimension stone, crude and partly worked:			
Calcareous	19,332	44,380	Syria 27,329; Iraq 7,953.
Other	2,123	4,470	Kuwait 3,539; Iraq 770.
Crushed stone and gravel	5,432	1,422	Syria 898; Saudi Arabia 270; Lebanon 254.
Sand	r 78	80	Mainly to Iraq.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen	10,715	8,271	Saudi Arabia 4,225; Syria 3,046; Yemen 1,000.
Coke and semicoke	--	45	All to Saudi Arabia.
Petroleum refinery products:			
Distillate fuel oil thousand 42-gallon barrels	r 29	37	All to Syria.
Residual fuel oil ---do---	r 9	--	
Liquefied petroleum gas ---do---	23	36	Mainly to Syria.
Other, n.e.s ---do---	r 1	3	Do.

r Revised.

Table 4.—Jordan: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
METALS			
Aluminum metal including alloys, all forms	r 999	1,186	Lebanon 487; Hong Kong 461.
Copper metal including alloys, all forms	r 403	87	Lebanon 17; Italy 16; Greece 11.
Iron and steel:			
Scrap	1,581	1,722	Syria 1,022; Kuwait 616.
Pig iron, ferroalloys, similar materials	30,694	13,401	Republic of South Africa 7,158; U.S.S.R. 5,000.
Steel, primary forms	--	24,196	Republic of South Africa 12,700; Australia 10,499.
Semimanufactures	r 55,896	65,277	Japan 12,970; United Kingdom 8,143; U.S.S.R. 5,804.
Lead:			
Oxides	--	271	United Kingdom 201; West Germany 40; Bulgaria 30.
Metal including alloys, all forms	1,770	1,760	Saudi Arabia 1,128; Syria 235; Lebanon 180.
Manganese oxides	--	120	All from Japan.
Tin metal including alloys, all forms	--	10	Sweden 5; United Kingdom 4.
Titanium oxides	139	104	Italy 46; United Kingdom 27; West Germany 20.
Zinc:			
Oxides	--	88	Mainly from West Germany.
Metal including alloys, all forms	--	129	Mainly from Japan.
Other metals: Base metals including alloys, all forms, n.e.s	47	21	Mainly from Turkey.

See footnote at end of table.

Table 4.—Jordan: Imports of mineral commodities—Continued

(Metric tons unless otherwise specified)

Commodity	1974	1975	Principal sources, 1975
NONMETALS			
Abrasives, natural: Grinding and polishing wheels and stones	53	100	Italy 54; West Germany 18.
Cement	7,874	7,909	Lebanon 4,815; Egypt 2,475.
Chalk	296	349	United Kingdom 170; Belgium-Luxembourg 111; Turkey 40.
Clay products:			
Refractory	882	926	West Germany 760; People's Republic of China 119.
Nonrefractory	2,679	2,390	Italy 768; Lebanon 613; Czechoslovakia 387.
Fertilizer materials, crude and manufactured:			
Nitrogenous	8,185	1,107	West Germany 580; Austria 200; Bulgaria 150.
Phosphatic	r 2,712	4,385	Italy 1,705; West Germany 1,686; Lebanon 555.
Potassic	310	961	West Germany 501; Kuwait 383.
Other, n.e.s	2,743	5,855	Kuwait 4,326; Lebanon 850.
Gypsum	--	690	Syria 409; Lebanon 180; West Germany 95.
Lime	1,716	1,865	Mainly from Lebanon.
Magnesite	--	10	All from United Kingdom.
Mineral pigments, manufactured	138	--	
Sodium and potassium compounds:			
Caustic potash, sodic and potassic peroxides	--	385	India 209; Italy 55; Japan 50.
Caustic soda	531	608	Italy 261; Kuwait 227; Syria 71.
Soda ash	425	440	Romania 200; Kenya 90; United Kingdom 85.
Stone, sand and gravel: Dimension stone: Marble	r 3,977	4,236	Italy 2,346; Lebanon 893.
Sulfur:			
Elemental	3,992	1,012	Kuwait 552; France 232; West Germany 147.
Sulfuric acid	2,903	3,846	Mainly from Kuwait.
MINERAL FUELS AND RELATED MATERIALS			
Asphalt and bitumen, natural	130	432	Mainly from Romania.
Carbon black	--	36	West Germany 12; Lebanon 10; Norway 10.
Coke and semicoke	646	429	Lebanon 314; West Germany 101.
Hydrogen, helium, rare gases	--	78	West Germany 34; Kuwait 15; France 8.
Petroleum:			
Crude ------thousand 42-gallon barrels--	r 5,674	6,313	All from Saudi Arabia.
Refinery products:			
Gasoline ----------do----	2	2	Mainly from Saudi Arabia.
Kerosine ----------do----	8	2	Do.
Lubricants ----------do----	r 75	69	Lebanon 17; Netherlands 13; United States 11.
Other, n.e.s ----------do----	1	1	Mainly from United States.
Total ----------do----	r 86	74	

r Revised.

LEBANON [7]

Lebanon's economy and small mineral industry, which consisted primarily of cement manufacture and petroleum refining, were seriously affected by the 19-month civil war which began in early 1975. Industries and banks were closed for most of 1976 and the annual inflation rate was close to 70%. At yearend, the Board for Reconstruction and Development was established and entrusted with drawing up a general reconstruction plan; proposing relevant economic, financial, and social policies; preparing a budget; and proposing legislation to assist the reconstruction effort. Other measures intended to revitalize the economy included the establishment of an organization to guarantee bank deposits at Lebanon's 74 private banks and to guar-

[7] Prepared by Candice Stevens.

antee local and foreign investments against noncommercial risks arising from the war. Top priority was given to repairing the financial center of Beirut and reequipping port facilities and other infrastructure. An $800,000 [8] grant from the United Kingdom was to finance a study by the United Kingdom firm Peat, Marwich, and Mitchell on the repairs needed at Beirut port, previously one of the busiest trading centers in the Middle East.

The civil disturbances resulted in both physical and financial damage to Lebanon's petroleum industry. During the year, the Higher Oil Committee was formed to supervise all oil imports, exploration activities, and the operations of Lebanon's two refineries. Shortages in the normal supply of oil products owing to the disruption in deliveries from Lebanon's refineries prompted the Government to increase the price of gasoline 76% to 79%. For most of the year, petroleum products and liquefied petroleum gas were imported from Saudi Arabia and Kuwait to the southern port of Sidon. The suspension of operations by many of Lebanon's oil distributing companies in 1976 was prompted by a combination of factors, including heavy damage to facilities, high labor costs, the difficulty of securing imports, and Government price regulation. Mobil Oil Lebanon Inc., the country's oldest petroleum company (established in 1919), and Esso Standard Near East discontinued business operations in August 1976. The Government subsequently established the Administrative Custodians Committee to supervise the companies' marketing and distribution of petroleum products. Shell Oil Co. and British Petroleum Company Ltd. (BP) pulled out later in the year after selling the share capital in their joint-venture marketing company to local employees. Total Liban Ltd., a subsidiary of Compagnie Française des Pétroles (CFP), relinquished 51% of its company valued at $3.2 million to local interests.

The nationalized Tripoli refinery in northern Lebanon ceased operating in March 1976 with the expiration of the supply agreement with the Iraq National Oil Company (INOC). At that time, Iraq began the diversion of its Kirkuk crude through the new strategic pipeline to export terminals on the Persian Gulf rather than by pipeline through Syria and Lebanon for export from Mediterranean ports. The Tripoli refinery reopened in December 1976 at 25% of capacity after Lebanon imported 350,000 tons of Kirkuk crude from Iraq. The oil, priced at $13.55 per barrel, was shipped by tanker from Basra port on the Persian Gulf. At yearend, advantages in both logistics and price led Lebanon to negotiate for the import of Saudi light crude for feedstock for the refinery. Logistically, the closure of the INOC pipeline and the necessity of importing Iraqi crude by tanker made the Saudi oil more easily available. In addition, following the inception of the Organization of Petroleum Exporting Countries' (OPEC) two-tiered price structure in January 1976, Iraqi crude (priced at $14.25 per barrel) was relatively more expensive than Saudi crude (priced at $12.49 per barrel). Some minor technical modifications would be required to enable the Tripoli refinery, which had a capacity of 30,000 barrels per day, to process the Saudi oil.

Lebanon's other refinery at Zahrani just south of Sidon terminated production in June 1976 following heavy damage to facilities. Earlier in the year, the refinery was supplied by limited deliveries of Saudi crude transported by TAPline. Although owned by the Mediterranean Refining Co. (Medreco), which in turn was owned by Caltex and Mobil Oil Corp., the 17,500-barrel-per-day refinery was taken under Government sequestration in 1973 following a price dispute with TAPline. The Medreco refinery resumed operations at half of capacity in November 1976, utilizing old stocks of crude oil as feedstock, and began supplying the local market with petroleum products in December 1976. At yearend, the Lebanese Government concluded an agreement with TAPline for deliveries of Saudi light crude at a price of $12.49 per barrel to the Medreco refinery to begin in January 1977. Payments were to be made on a quarterly basis with approximately $12.5 million due on April 1, 1977, for 1 million barrels of crude oil to be delivered during the first quarter. At the same time, the payment of the Lebanese Government's debts for past crude oil shipments, estimated at $123 million, was suspended indefinitely.

[8] Where necessary, values have been converted from Lebanese pounds (£L) to U.S. dollars at the rate of £L2.27=US$1.00.

Petroleum exploration, which had been conducted on a modest scale in Lebanon since 1947,[9] was interrupted in 1976. Lebanese Decree 10537 of July 1975 authorized the Government to invite companies to bid for offshore acreage under production-sharing terms and to review all existing prospecting rights. However, both the bidding and review of permits were necessarily postponed during the year. Onshore rights were previously held by Compagnie Libanaise des Pétroles (CLP), Shaheen Oil Co., and Abdeni Oil Co.; offshore rights were held by a group composed of Shaheen, Oxoco (UK) Limited, and Invent Inc.

OMAN [10]

Oil continued to be the foundation of Oman's economy, accounting for 99% of the exports and 70% of the GNP, estimated at $1.8 billion [11] at current prices. Petroleum production increased 7% in 1976 and Government revenues derived from petroleum increased 25% to nearly $1.3 billion. The Government was seeking to develop northern Oman mineral deposits, including copper, asbestos, limestone, chromite, iron ore, phosphates, and coal.

The 5-year development plan (1976–80), the first ever issued in the sultanate, highlighted the need for tight budgets and slower growth until the end of the decade as petroleum output was expected to decline. Resources for the plan were to be derived from oil revenues ($6.5 billion), customs and taxes ($4.6 million), and loans and grants ($1.2 billion). Oil revenues were expected to be 25% lower by 1980 than they were in 1976. Funds were to be shifted from infrastructure projects to rural development and revenue generating projects such as mining, manufacturing, and agriculture. Side effects of the economic slowdown caused by slackening in large infrastructure projects included a sharp drop in the Matrah port congestion, a decrease in inflation from 80% in 1973 to 15% in 1976, and an expected decline in the foreign work force.[12]

The Oman Development Bank was launched, with shareholding scheduled to be by the Government (40%), foreign financial interests (40%), and the Omani public (20%). There were only three exceptions to the rule that all businesses in Oman be operated by local companies—Government contractors, banks, and the technical professions.[13] Although there was a choice of five types of enterprises that could be established with foreign capital, experts were recommending either a joint stock enterprise following a standard format or a limited liability enterprise with a restricted number of shareholders. The Omani stake was expected to be at least 35% for most businesses and no joint operation was eligible to buy land. Corporate income tax was on a sliding scale from 5% to 50% of gross profits. A 5-year tax holiday was allowed to companies that were either wholly Omani owned, involved in industry, or considered to contribute to the national economy and have a capital of at least $290,000. In addition, there was a 5% maximum payroll tax and a customs duty of 2%, but no personal income tax or exchange control regulations for companies with 50 or more employees. On September 9, 1976, the Omani Government signed an agreement that authorized the Overseas Private Investment Corp. (OPIC) to provide insurance for U.S. investors and contractors operating there.

Plans were being formulated for the establishment of the Oman Cement Co., to be owned 60% by the Sultanate of Oman and 40% by the Kuwait Cement Co. The plant would produce cement at a rate of 1 million tons per year. It was hoped that the plant would start production before 1980. The Government cancelled a deal with Associated Portland Cement Manufacturers Ltd. (APC) of the United Kingdom to establish a cement plant near Muscat. The cancellation was decided because of disagreement with APC

[9] Beydoun, Z. R. Petroleum Prospects of Lebanon: A Reevaluation. Am. Assoc. Petrol. Geol. Bull., v. 61, No. 1, January 1977, pp. 43–64.

[10] Prepared by Janice L. W. Jolly, physical scientist, International Data and Analysis.

[11] Where necessary, values have been converted from Omani rials (RO) to U.S. dollars at the rate of RO0.345=US$1.00.

[12] U.S. Embassy, Muscat, Oman. State Department Airgram A–79, Dec. 15, 1976, 10 pp.

[13] Financial Times (London). Competition Gets Tough in Oman. Jan. 31, 1977, p. 23.

on terms for the supply of gas and other utilities.

Except for sand and aggregate, Oman was totally dependent on foreign construction material. Oman imported about 300,000 tons of cement in 1976. Steel and cement represented about 40% of the recorded imports.[14] Although the price of cement locally increased only 6% between March 1974 and March 1976, the costs for labor increased 15%. The labor element in construction costs was reported to be as high as 78% on buildings. The bulk of the workforce was made up of expatriates, mostly from the Indian subcontinent for the basic grades and from Europe and the United States for the managerial staff. The construction industry accounted for 77% of the jobs in the private sector.

The development of the Sohar copper mining and smelting complex was to require a 200-kilometer natural gas pipeline to be laid from Ghabar to Sohar. The copper deposits were estimated to contain at least 20 million tons of copper ore averaging 2.1% copper. Extraction, refining, and development were expected to cost over $150 million. A joint venture (to be known as the Oman Mining Co.) between the Omani Government (51%), Prospection Ltd. of Canada, and Douglas B. Marshall Exploration of Houston, Tex., was to develop the deposit. Loans of $223 million and $420 million, largely representing external capital from Saudi Arabia and Abu Dhabi, were being utilized both for Dhofar development and the Sohar copper project. Exploration and other technical services had been undertaken by Prospection Ltd. No firm date for startup of operations had been announced, but the fact that most of the capital had been arranged suggested that work would begin soon. More drilling was required to complete feasibility studies. Some reports suggested that there were up to six other known copper deposits in the area. Three underground mines were visualized as supplying 3,000 tons of ore per day to a central processing complex. The mineralized area was located 40 kilometers inland from Sohar, a fishing town in northern Oman. The deposits were described as geologically similar to those in Cyprus, which were associated with pillow lavas of the Troodos Massif.

Petroleum Development (Oman) Ltd. (PDO), controlled 60% by the Omani Government and 40% by Shell, CFP, and Participations and Explorations Corporation (Partex) (Portugal), was the country's only petroleum producer, producing an average of 365,558 barrels per day in 1976 from nine fields, up 7% over that of 1975. The majority of the production (52%) came from the Fahud-Natik (discovered in 1964) and Yibal-Shuaiba (discovered in 1962) Fields. Oman was not a member of OPEC, but was following the price increase by adding $1.05 per barrel, effective January 1977. During 1976, the Omani Government took a vigorous role in negotiating prices with Shell by raising taxes and royalties on equity of crude oil to 80% and 20%, respectively, thus making the rates about the same as those of other Persian Gulf countries. Omani blended crude oil (35° API gravity) was selling at $11.70 per barrel in 1976. In the first 6 months of 1976, the chief importers of Omani crude were Japan (39.7%), the Netherlands (18.8%), the United States (15.7%), and Canada (10.7%). France, the United Kingdom, Singapore, Italy, West Germany, and Trinidad also imported crude petroleum from Oman.

Petroleum reserves in northern Oman were expected to be nearly depleted in 20 years. Petroleum production was expected to start declining in 1977. In an effort to balance the expected oil production decline, PDO had plans to spend $200 million to $250 million on development of the Dhofar area now that the conflict was at an end. Reportedly, proven reserves in this area could provide at least 30,000 barrels per day, the minimal economic recovery level. In an effort to increase exploration efforts in Dhofar, the Government was inviting bids on about 25,000 square miles on a production-sharing basis.

Test wells drilled at Amal, Nasir, and Marmul Fields in the Dhofar area revealed significant reserves of heavy to medium oil (24° API gravity), but commercial recovery was expected to be difficult. Not only do the fragmented oil-bearing strata in Dhofar present problems in development, but the oil would apparently have to be piped over steep cliffs to a marine pumping station that would be vulnerable to severe summer monsoon

[14] Financial Times (London). Government Cuts Back. July 21, 1976, p. 24.

weather. PDO expected that any oil produced would be costly and command a lower market price than light crude oil from the north.

During 1976, 39 wells were completed in Oman, down from the 53 completed in 1975. Of these, 29 tested oil, 7 were dry, and 3 were suspended. The Royal Dutch/Shell Group as operator for PDO drilled six of the wells that tested oil, abandoning four. Three of these were in the Dhofar area, one was northeast of Fahooud, and two were in central Oman. Sun Oil Co. drilled and abandoned one well off the east coast of Oman, south of the Gulf of Masira. Elf-Aquitaine and the Sumitomo group were drilling off the northern tip of Oman in the Strait of Hormuz. Elf-Aquitaine had changed its conventional exploration permit for Cape Musandam into a production-sharing agreement. Essence et Lubrificant de France—Entreprise de Recherches et d'Activités Pétrolières (Elf-ERAP) struck light oil at depths of 12,000 feet in the Strait of Hormuz, northwest of Cape Musandam, early in 1976. A U.S. independent company, Quintana Overseas International (owned by Marshall Exploration), leased the Sunaina Field in northern Oman and was to start drilling in 1977.

The Italian companies SNAM Progetti S.p.A. and Saipem S.p.A. (subsidiaries of Ente Nazionale Idrocarburi (ENI) announced the acquisition of a $32 million turnkey contract for construction of a 20-inch diameter, 331-kilometer long natural gas pipeline from the Yibal Field in the Fahud area in north-central Oman to the capital city of Muscat. The project was expected to be completed by early 1978. The Abu Dhabi Fund for Arab Economic Development was loaning $15 million, the Kuwaiti Fund for Arab Economic Development, $25 million; Saudi Arabia, $20 million; and the Arab Fund for Economic and Social Development (AFESD), $20 million toward the $94 million total expected cost to construct the pipeline. The gasline was to serve industrial projects of the 5-year plan such as a projected 2,000-ton-per-day fertilizer plant, a cement plant, and power-generating and water-desalination plants. According to a recent Government study, Oman has sufficient natural gas reserves to sustain a production of 12 billion cubic meters per year for 20 years.[15]

Under consideration were a $30 million topping plant and a 30,000-barrel-per-day oil refinery. The refinery was expected to cost $130 million, but Oman's annual imports of refined products were at a rate of over $100 million.[16] In the first 6 months of 1976, Oman imported 420,000 barrels of gasoline, 200,000 barrels of jet fuel, 600,000 barrels of distillate fuel oil, and 2.4 million barrels of residual fuel oil from Iran; and 25,000 barrels of gasoline, 28,000 barrels of jet fuel, and 40,000 barrels of distillate fuel oil from Saudi Arabia. Similar amounts were imported in the second half of the year. The sole importers of refined products in Oman were Shell and BP.

QATAR [17]

Fueled by substantial oil revenues, the economy of Qatar was developing at a rapid pace. Qatar's oil income of $2.1 billion [18] comprised over 50% of the 1976 GNP estimated at $4 billion at current prices. The Government was attempting to conserve oil resources with 25% of the possible production shut in and the production ceiling lowered to 475,000 barrels per day on January 1, 1976. Oil reserves were expected to last about 25 years, but reserves of natural gas were expected to have potential for hundreds of years after the oil runs out. The Government acquired 100% control of oil production during 1976 and early 1977.

The Government actively encouraged foreign investment, especially for industrial projects. There was a legal requirement that all local companies must have 51% Qatari ownership, although exemptions could be obtained by special decree. Imported equipment and material were exempt from duties and industrial ventures were entitled to a 5-year tax holiday.

[15] Petroleum Economist (London). Oman. V. XLIII, No. 10, October 1976, p. 401.
[16] U.S. Embassy, Muscat, Oman. State Department Telegram 1495, Oct. 22, 1977, 1 p.
[17] Prepared by Janice L. W. Jolly.
[18] Where necessary, values have been converted from Qatar riyals (QR) to U.S. dollars at the rate of QR3.9391 = US$1.00.

There were no personal income or municipal taxes. Government assistance was also available through capital participation, long-term interest-free loans, or provision of free land.

Economic cooperation between Qatar and France had increased with the signing in December 1975 of agreements providing Banque de France with $150 million for joint petrochemical project financing—one in Qatar at Umm Said and the other in France at Dunkerque. An Anglo-Qatari trade agreement was signed in July 1976 providing for establishment of a joint committee to stimulate the involvement of United Kingdom firms in Qatari development projects and training programs. Finland also participated in discussions aimed at developing intergovernmental cooperation.

Electricity generating capacity was approximately 801 megawatts in 1976. Qatar was largely dependent on desalinated water both for drinking and industrial consumption. There were occasional water shortages, but additional desalination plants were to be built, along with new powerstations projected to meet the needs of the country within 3 years. Doha's heavily congested six-berth port was being expanded and contracts were awarded for construction of eight berths at Umm Said to service the industrial area. Further port studies recommended 20 additional berths.

The absence of a technically or administratively trained indigenous population resulted in heavy reliance on foreign labor, and the lack of an established infrastructure or industrial base created bottlenecks for the economy. Foreign labor was supplied principally from other Arab countries, India, Pakistan, and Iran. There were shortages of both skilled and unskilled labor in all areas of the economy, a factor that has slowed industrial development.

Imports from the United Kingdom, Japan, the United States, and West Germany formed more than 50% of Qatar's total imports. Total 1976 imports were valued at $835.5 million. The 1976 figure was more than twice that of 1975 ($407.5 million). The U.S. share dropped from 12.5% to 7.8%, and Japan replaced the United Kingdom as the leading supplier with 28.3% of Qatar's imports in 1976.

Startup of Qatar Steel Co.'s 400,000-ton-per-year direct-reduction steelworks was set for February 1978. Although feed was to be imported, the plant was to use local natural gas as fuel and reductant, using the Midrex process. The Taisei Corporation of Japan and the Jung Woo Development Co. of the Republic of Korea were jointly building the steelworks. The steelworks at Umm Said was owned as a joint enterprise between the Qatari Government and Kobe Steel, Ltd., and Tokyo Boeki Ltd. of Japan. Kobe Steel, with a 20% interest, was supervising the project. When completed, the Midrex direct-reduction module will consist of two 70-ton electric arc furnaces, two 4-strand continuous billet casters, and a bar mill, and will produce rebars for the construction industry. Iron ore and pellets will be imported from Australia, Brazil, and Sweden. Some scrap will also be imported.

A third furnace for cement production was being built with a capacity of 100,000 tons per year, and a fourth plant at Umm Bab with a 900-ton-per-day capacity was planned for 1978. Newell Dunford Engineering Ltd. was given a contract to supply a complete lime calcination plant at Umm Bab for the Qatar National Cement Co. Ltd. Consultant for the project was Henry Pooley Atkins of Epsom, the United Kingdom. Hydraulic cement valued at $8.6 million (171,503 tons) was produced in 1976 and 208,800 tons of cement was imported. A prefabricated concrete factory was to be constructed by several West German companies.

Drilling in Qatar during 1976 resulted in the completion of 15 wells—4 yielded oil, 4 yielded gas, 1 was dry, 2 were suspended, and 4 were service wells. Total footage was 115,500 feet. At yearend, there were three wells in progress. There were six rigs operating in the country, two offshore and four onshore. The high price of crude oil made it possible for the Holcar Co. to begin production at a rate of 10,000 to 20,000 barrels per day from three offshore wells in 1977. The wells were on a 7,500-square-kilometer tract relinquished as noncommercial by the Japanese Qatar Oil Co. in 1973. In wildcat activity, Holcar Petroleum, an independent U.S. company, began exploration of the former Japanese tract. The Wintershall group was exploring its concession off the

northern tip of Qatar. Two wildcat wells were completed—one was an oil discovery and the other a gas discovery with oil shows. The offshore El Bunduq oilfield, straddling the boundary between the United Arab Emirates and Qatar, was expected to reach its full productive potential of 30,000 barrels per day; the well started production in February.

Petroleum production in 1976 averaged 495,000 barrels per day, up 13.9% over that of 1975. This figure includes the 20,000-barrel-per-day production of the El Bunduq Field which was shared with Abu Dhabi because the Field straddles the boundary. The remaining quantity was produced about equally by Shell-operated offshore fields and the Qatar Petroleum Company Ltd. (QPC)-operated onshore Dukhan Field. Of the offshore fields, Bul Hanine was the largest, averaging 141,000 barrels per day.

Under terms of an agreement signed on September 16, 1976, the Government took over the remaining 40% interest in the assets of the onshore producing company QPC. QPC was previously owned by BP, Royal Dutch/Shell, and CFP, each originally with 23.75%; Exxon and Mobil (Near East Development Corp.), each with just under 11.88%; and Partex with 5%. Compensation amounted to about $30 million. The Government company would be called the Qatar Petroleum Producing Company (QPPC). The former private owners were to establish Dukhan Service Co. Ltd., a company for management and operational services. The companies' service fee was to be 15 cents per barrel of oil produced, indexed to the price of Dukhan crude. This was reportedly the first service fee indexing arrangement in the Middle East. The Qatar arrangement was pegged at 1.266% of the crude oil price, which was $11.848 per barrel of Dukhan crude.[19] Under a 5-year contract, the companies were entitled to restricted liftings of 130,000 barrels per day with 60 days' credit. This compares with the 170,000 barrels per day allowable under the 1976 equity and buy-back arrangements. The onshore Dukhan Field, discovered in 1940, was producing at a rate of 225,000 barrels per day.

The Government was still to negotiate terms for the takeover of offshore operations by the Shell Company of Qatar Limited (SCQ) in which 80% of the foreign interests were held by Shell and the remainder by Italy's ENI. SCQ's three offshore fields, Idd El Shargi (discovered in 1960), Maydan Mahzan (discovered in 1963), and Bul Hanine (discovered in 1970), were producing about 245,000 barrels per day. The negotiations, expected to be concluded in February 1977, were to take longer with Shell because of the more exacting technical and operational requirements of the offshore operations and the need for substantial further exploration and development work. Shell was expected to receive a higher service fee, indexed to the price of Qatar Marine crude, which was to also apply to natural gas liquids when the projected natural gas plant was completed in 1979.

A decree was issued October 16, 1976, establishing the Qatari Petroleum Production Authority (QPPA) within the Qatar General Petroleum Corp. (QGPC), to be headquartered in Doha, to oversee petroleum production. The QPPA was to be independently budgeted. The decree was issued as part of the administrative revisions brought about by the complete nationalization of oil resources by the Government.[20] Marketing was controlled by the State oil company QGPC which was formed in 1974 in anticipation of the takeover.

OPEC held a meeting in Doha on December 15–17, 1976, at which Qatar and 10 other countries decided to increase the price of marker crude 10% from $11.51 per barrel to $12.70 per barrel as of January 1, 1977, and 5% to $13.30 per barrel as of July 1, 1977. The prices of all other crudes were to be increased by the same percentages. Saudi Arabia and the United Arab Emirates decided to raise their prices 5% only. Qatar was also a member of OAPEC, a group of 10 Arab States that functions to coordinate projects (oil-tanker groups, special funds, etc.) among the Arab producing States.

Universal Oil Products Management Services of the United States was carrying out a market survey and feasibility study for the construction of the new oil refinery in Qatar. The study was to determine the capacity, expected to be between 50,000

[19] Oil and Gas Journal Newsletter. Nov. 1, 1976, p. 1.
[20] U.S. Embassy, Doha, Qatar. State Department Airgram A-27, Nov. 1, 1976, p. 1.

and 80,000 barrels per day. Cost of the refinery was estimated at $150 million. The refinery was to serve mostly local needs. The National Oil Distribution Co. refinery at Umm Said had a capacity of 9,150 barrels of crude oil per day. Petroleum refinery input for 1976 was 1,964,869 barrels of crude oil.

Qatar Gas Co. let a $70 million contract to the Japanese companies Mitsubishi Corporation and Chiyoda Chemical Engineering & Construction Co., Ltd., for building the 7.3-million-barrel-per-year natural gas liquids plant (NGL–2) at Umm Said. The plant was to produce 5 million barrels per year of propane and butane and 2.3 million barrels per year of gasoline, and was scheduled to come onstream in 1979. A gas-gathering network to service NGL–2 totaling some 290 kilometers was already under construction by ENI's subsidiary Saipem under a $23 million contract let in April 1975. This would be the second natural gas liquids plant in Qatar.

The first natural gas liquids plant at Umm Said (NGL–1) utilized gas from the Dukhan Field. It was completed in 1975 and consisted of a gas-gathering and initial processing plant at Fahahil near the Dukhan Field; a 12-inch diameter, 60-mile long pipeline to move the liquids to Umm Said; facilities for delivery of dry gas to various industrial plants and utilities; and the fractionation plant and export facilities at Umm Said. Exports were mainly to Japan. Design gas-processing capacity was 340 billion cubic feet per day. Production capacity was 20,000 barrels per day of propane, 8,000 barrels per day of butane, and 4,000 barrels per day of pentanes. Besides fueling local industries, the dry gas provided feedstock for Qatar Fertiliser Co.'s (QAFCO) plant. In 1976, 64,382 tons of liquefied petroleum gas (from natural gas only), 118,486 tons of propane, and 110,356 tons of butane were produced.

QAFCO's fertilizer plant, owned 70% by the Government, 25% by Norway's Norsk Hydro AS, 3% by the United Kingdom's Power-Gas Ltd., and 2% by Hambros Bank Ltd., was completed in 1973. Export oriented, this project had a planned output of 900 tons per day of ammonia and 1,000 tons per day of urea. In 1976, Mitsubishi and Chiyoda received a $19 million contract from QAFCO for an additional 1,000-ton-per-day urea plant for the Umm Said complex. Based on Stamicarbon B.V.'s technology, the new plant was due to come onstream by mid-1978, together with a new 300,000-ton-per-year ammonia plant. Costain Process Engineering Ltd. of the United Kingdom was to build the new ammonia plant under a contract worth $15.6 million, and Norsk Hydro was to manage and operate the plant and market the products.

Natural gas liquids from NGL–2 would be used for a new petrochemical plant planned by Qatar Petrochemical Co. (QAPCO), an enterprise owned 80% by the State, 15% by Charbonnages de France Chimie (CDF Chimie), and 5% by another French company, Gazocean. Contracts for this complex were recently let for $200 million to the French company Cie. Française d'Etudes et de Construction Technip to build a steam cracking unit for production of 280,000 tons per year of ethylene, and for $80 million to the Belgian company Coppee-Rust S.A. for a unit to convert the ethylene to 140,000 tons per year of low-density polyethylene and other products. Due for completion in 1982, the enterprise will also include a transport company in which the Government will have 60% interest and Gazocean, 40% interest. CDF Chimie will operate the plant and handle marketing. Gazocean will ship about half of the output to France in liquid form. The remainder will either be transformed into low-density polyethylene locally or used in other downstream products.

The huge offshore gasfield discovered by Shell was located northeast of the Qatar peninsula in the Khuff formation of the northwest Dome area and was estimated to have reserves of over 100 trillion cubic feet. These new gas reserves were expected to provide the base for an important future natural gas liquids and petrochemical export trade.

Table 5.—Qatar: Exports of crude oil, by destination
(Thousand 42-gallon barrels)

Country	1974	1975	1976
Australia	3,906	1,789	1,898
France	29,018	11,826	26,171
Germany, West	5,183	7,446	5,439
Italy	20,805	15,659	11,206
Japan	1,716	511	1,460
Netherlands	5,950	27,375	30,916
Philippines	3,066	--	--
Sweden	5,183	511	3,030
Thailand	17,995	10,184	16,900
United Kingdom	35,405	20,002	21,134
United States	621	32,157	33,142
Yemen, People's Democratic Republic of	1,789	621	2,154
Other	55,951	28,249	24,159
Total	r 186,588	156,330	177,609

r Revised.

Source: Organization of Petroleum Exporting Countries, Statistics Unit. Annual Statistical Bulletin 1976 (Vienna). 1977, p. 71.

Table 6.—Qatar: Imports of petroleum refinery products
(Thousand 42-gallon barrels)

Product	1974	1975	1976
Gasoline	369	41	--
Jet fuel and kerosine	158	139	--
Distillate fuel oil	405	--	--
Lubricants	14	34	35
Other	147	181	--
Total	1,093	395	35

SYRIA [21]

Although increasing petroleum revenues contributed to the growth of Syria's gross domestic product (GDP) to nearly $6 billion [22] in 1976, Syrian involvement in the civil disturbance in Lebanon had an overall adverse economic effect. An average annual inflation rate of more than 30% and the presence of a large refugee population put pressure on Government-controlled food and fuel prices, leading to a 60% increase in the price of gasoline. The draft budget for 1977 was $4.6 billion, of which $1.8 billion was allocated for general expenditures and $2.8 billion for development projects. Approximately $330 million was to be devoted to oil and mineral resource development, which included continued petroleum exploration, a general geophysical survey covering 24,000 square kilometers, and the completion of fertilizer, cement, and refinery projects already under construction. In addition, the Romanian firm Geomin finalized a $600,000 agreement to prospect for industrial minerals for construction purposes.

In 1976, Syria continued its policy of diversifying its trade and aid partners and of cultivating new sources of finance and technology other than the U.S.S.R. and Eastern Europe. Financial assistance totaling $355 million was received from Arab oil-producing countries in 1976, and loans of $750 million were expected in 1977. Eastern Europe dropped from its position as Syria's largest trading partner, accounting for less than 16% of imports and 20% of exports in 1976, while Western Europe had more than a 50% share in both the import and export markets. Petroleum was Syria's largest export earner, accounting for about 65% of total revenue, while phosphate exports contributed 2% of revenue. Overall, Syria suffered a balance of trade deficit of approximately $600 million in 1976 owing to large imports of capital equipment and machinery needed for development projects and defense.

[21] Prepared by Candice Stevens.

[22] Where necessary, values have been converted from Syrian pounds (£S) to U.S. dollars at the rate of £S3.90=US$1.00.

Several new economic measures were introduced since 1974 in the effort to attract foreign private and government investment in Syria's development program. These provisions included tax incentives for private investors, the liberalization of foreign exchange controls, bilateral treaties guaranteeing investments against nationalization, allowances for the repatriation of up to 50% of company profits, and the establishment of six new free zones in Adra, Tartus, Aleppo, Latakia, Damascus, and Deraa-Ramthā.

Syria's 5-year plan provisionally accorded high priority to the development of both transportation and electricity generating power. In 1976, Syria had 6,920 kilometers of asphalt-covered roads in addition to 1,126 kilometers of other surfaced roads; considerable resources were to be devoted to improving and expanding this network. The major ports of Banias, Latakia, and Tartus, which experienced a large increase in traffic in 1976 owing to the closure of Lebanese ports, were to be expanded and modernized. The Yugoslav firm Pomgrad was awarded a $19 million contract for the Latakia port expansion, which involved the construction of a 710-meter breakwater to increase the port's capacity from 1.6 million tons to 3 million tons per year. Technoexport (U.S.S.R.) was also preparing studies for the installation of additional piers and other facilities to be completed in 1979.

A vast rural electrification program and the full commissioning of the Euphrates Dam powerstation were to raise Syria's power generating capacity to about 2,500 megawatts by 1980. East Germany donated $51 million to the rural electrification program, which included 300-megawatt stations at Banias and Muhradah and a 180-megawatt steam turbine plant at Qutnah. In addition, the U.S.S.R. was to supply three powerstations of 100 megawatts each. Two turbines had yet to be commissioned at the Euphrates Dam station which was to have a total capacity of 800 megawatts. The $325 million dam, completed in 1974 with U.S.S.R. financial and technical assistance, was to provide the bulk of Syria's electricity in the next few years and the basis for an extensive irrigation program.

Syria's petroleum production increased from 65.9 million barrels in 1975 to approximately 70 million barrels in 1976. Proven commercially recoverable reserves were 1.75 billion barrels in five fields: Suwaidiyah, Karatchuk, Rumailān, Djubissa, and Olayan. The Suwaidiyah Field was the largest with over 1 billion barrels of reserves. The Djubissa Field, situated 40 kilometers south of Al Hasakah, came onstream in mid-1975. The new Olayan Field, in the extreme northeast of the country, started production in mid-1976 at an initial rate of 10,000 barrels per day. A 300,000-barrel-per-day capacity pipeline carried crude oil from the five fields by way of Homs, where a small volume of oil was taken off for refining, to the Tartus export terminal on the Mediterranean Sea.

Although Syria produced more crude oil than it could use domestically, its single refinery at Homs was not equipped to refine the high-sulfur Syrian crude oil without blending it with light Iraqi oil. However, the supply of Iraqi Kirkuk crude ceased in April 1976 when Iraq diverted its oil exports southward through a new pipeline to the Basra terminal on the Persian Gulf instead of to the Mediterranean ports of Banias in Syria and Tripoli in Lebanon. This followed a failure to agree on new levels of transit fees payable to Syria by INOC and on the cost of crude oil which Iraq formerly supplied the Homs refinery at a preferential rate. In 1975, an average of 900,000 barrels per day of crude oil transitted the INOC pipelines, which had a capacity of 1.4 million barrels per day, earning Syria nearly $150 million in transit dues. Oil transit revenues in 1976 were minimal owing to the closure of the INOC pipelines and the failure to reopen the TAPline, which closed in February 1975.

The capacity of the Homs refinery was expanded during the year from 2.5 million tons to 5 million tons per year and a new lubricating oil plant was planned. Despite the purchase of 200,000 tons of oil from Saudi Arabia and a gift of 100,000 tons of oil from Abu Dhabi, the Homs refinery did not operate at full capacity in 1976 owing to the loss of Iraqi crude. A new refinery under construction at Banias by Romania's Industrialexport was to undergo a modification of its refining process from a mixture of 80% Iraqi crude (36° API gravity) and 20% Syrian crude (25° API gravity) to a mixture containing 50% Syrian crude. The original $297 million

contract provided for the construction of a 6-million-ton-per-year refinery to be completed in 1977. A supplemental agreement concluded in 1976 provided for the study, design, supply, and installation of equipment required for the processing modification and delayed startup until 1978.

Syria's attempt to engage international firms in oil exploration met with unsuccessful results in 1976. Approximately 50,000 square kilometers of area onshore and offshore was opened to international bids under production-sharing or service-contract arrangements in 1975. Contract provisions included recoverable company costs from 40% of production, negotiable production-sharing ratios, minimum exploration commitments, and competitive signature and production bonuses. Although a U.S. consortium consisting of Tripco Petroleum Co., Reserve Oil & Gas Co., Drillamex (a subsidiary of American Express Company), and City Investing Co. acquired a 4,500-square-kilometer offshore block, it relinquished the acreage in May 1976 after completing seismic surveys. Similarly, Chemokomplex of Hungary withdrew its bid for an exploration tract in central Syria. The only remaining foreign interest was Rompetrol of Romania which was prospecting on a 9,350-square-kilometer onshore tract in the northeastern part of the country.

The Syrian Petroleum Co. (SPC), the Government concern responsible for production and exploration, continued prospecting in five blocks totaling 25,000 square kilometers in the northeast, the southwest near Damascus, the northwest south of Aleppo, and the south-central areas of the country. In the past 2 years, SPC discovered four new oilfields of varying size: The Tishreen near the Djubissa Field, the Habari in the Aleppo block, and the Salhié and Gebebeh in the extreme northeast. In 1976, the SPC was active in wildcat drilling employing Rompetrol and a Yugoslav firm as contractors and receiving technical assistance from the U.S.S.R.

The major part of Syria's natural gas production, estimated at 60 billion cubic feet annually, was flared in 1976 as in previous years. During the year, the SPC invited bids on a $40 million project to gather and process associated gas from the Suwaidiyah, Karatchuk, and Rumailān oilfields. The project, which was to be completed in 1978, included gas-gathering lines, trunklines, compressor stations, processing units, and supporting facilities. Production would consist of liquefied petroleum gas for home use, light gas fuel, industrial solvents, and sulfur. In addition, the Syrian Union of Engineering and Chemical Industries (UNICHEM) invited bids for prospecting for sulfur in the Al Jazīra area in northeastern Syria.

The production of phosphate decreased from 857,000 tons in 1975 to approximately 511,000 tons in 1976. Syria's three principal phosphate mines, Khunayfis and Sharqīyah A and B, were situated in the central part of the country about 50 kilometers south of Palmyra. About 40% of the production was exported, primarily to the Eastern European countries of Romania, Bulgaria, and Czechoslovakia.

In 1976, Cremer and Warner (United Kingdom) was contracted to act as technical adviser to the Syrian General Establishment of Chemical Industries (GECI) on all fertilizer projects. Three new fertilizer plants were to supplement Syria's single facility at Homs, which had a capacity of 110,000 tons of ammonia per year. Creusot-Loire Entreprise (France) was managing contractor for a nitrogen fertilizer plant under construction at Homs that was to produce 1,000 tons of ammonia and 1,050 tons of urea per day. The plant was due for completion in 1979. Industrial-export completed basic construction on a 1,400-ton-per-day triple superphosphate plant at Homs. The $180 million plant was to begin production in 1977. Industrialexport was also the contractor for a second triple superphosphate plant that was to be built in Deir el Zour in the northeast and have a capacity of 1,000 tons per day.

The exploitation of iron ore deposits in three areas of the country was under consideration by the General Establishment for Geology and Mineral Resources. Reserves at Rājū, 97 kilometers northwest of Aleppo, were estimated at 60 million tons of ore containing 31% iron; reserves in the Al Qadmūs region west of Damascus were estimated at 20 million to 30 million tons of ore containing 25% to 30% iron; and smaller deposits at Az Zabdānī were estimated to have an iron content of 30% to 35%. In 1976, approximately 3,400 tons of

ore was sent to North Korea for testing and feasibility studies.

The production capacity of the iron and steel complex at Hama was to be increased to 300,000 tons of product per year. An iron rod factory with an annual capacity of 110,000 tons of rod was recently installed. A metal pipe factory, which was to produce 20,000 tons of pipe per year, was under construction by Demag AG (West Germany). A sponge iron smelting factory was under construction by Brown Boveri Co. (United Kingdom). Studies were also being conducted regarding the construction of an iron plate unit and a factory to manufacture sheet steel.

PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN [23]

The mineral industry of the People's Democratic Republic of Yemen (PDRY) made a significant contribution to the 1976 GNP estimated at $200 million.[24] Mineral activity was limited to the production of salt and the refining of imported crude petroleum, but these commodities accounted for nearly 80% of total export value. The goals of the 5-year plan (1974–78), which scheduled a total expenditure of $225 million, included the intensification of oil and mineral exploration and the development of industries using local raw materials. An investment of $19 million was earmarked for mineral resource development in 1977, a 30% increase over 1976 expenditures in this sector. Both the Government and foreign companies were to continue oil and mineral prospecting, technical studies for a cement industry were to be conducted, and a salt factory was to be reopened.

In 1976, an agreement was concluded for the Government takeover of the nation's sole refinery operated by BP Refinery (Aden), Ltd. BP was to remain as operator for the refinery, which was to come under official Government control on May 1, 1977. Although the refinery was operating at 25% of its rated capacity of 160,000 barrels per day, it provided approximately 80% of the industrial output of PDRY. Built by BP in 1954, the refinery processed crude oil imported from Qatar, Kuwait, the United Arab Emirates, and other Arab States. In 1976, PDRY established diplomatic relations with Saudi Arabia and sought economic aid to finance the upgrading of the refinery as well as a source of crude oil.

Petroleum exploration continued under the production-sharing arrangements offered by the Government in 1975. Siebens Oil & Gas Ltd. (Canada) was to spend $14.5 million on drilling two wildcat wells in its 17,553-square-kilometer concession area in southern Socotra Island and its offshore area. In 1976, the company spudded a wildcat well, 1 Samhah, 113 kilometers southwest of Socotra Island in 380 feet of water. The U.S.S.R. firm Technoexport continued exploration in its 10,000-square-kilometer tract of the Thamud area. The South Yemeni Algerian Petroleum Co. (SYAPCO), a joint exploration company founded in 1971 by the Yemen National Oil Co. and the Algerian firm SONATRACH, was liquidated in 1976.

The Government also planned to expand its petroleum exploration program in 1977. A central administration was established within the Oil and Minerals Organization to supervise and coordinate all prospecting activity. In 1976, aerial surveys covering 10,000 square kilometers were conducted, seismographic surveys of the Ras Fartak area were completed, and exploratory wells were drilled in the Thamud region.

The country's large salt industry declined after 1970 owing to the loss of foreign markets. Salt production at the State-owned General Salt Organization facilities at Khawr Maksoir near Aden was chiefly for local consumption. The capacity for producing unrefined marine salt from the evaporation of seawater was rated at 80,000 tons per year. In June 1976, work was initiated on the reconstruction of a salt factory with assistance from the People's Republic of China.

Hunting Geology and Geophysics Ltd. (United Kingdom) was contracted for a second year of mineral exploration by the Board of Petroleum and Minerals. The $1.7 million contract was to involve prospecting and drilling of copper occurrences in the Maahir-Ghabar area, 50 kilometers

[23] Prepared by Candice Stevens.

[24] Where necessary, values have been converted from Yemeni dinars (SYD) to U.S. dollars at the rate of SYD1 = US$2.90.

southwest of Mukalla, and the investigation of heavy minerals in beachsands along the coast. In 1976, the use of geological mapping, geochemistry, and geophysics resulted in the identification of four main targets in the copper area for further drilling. Sampling was in progress to confirm preliminary estimates of the ilmenite, zircon, and rutile content of beachsands in five zones. Mineralogical and geochemical laboratories were set up in Mukalla for the training of Yemeni personnel.

The Government was to continue its magnetic and radial surveys of the western region and its geological survey of iron and titanium resources in the Wadi Mikayris region.

Nearly 25% of the expenditures in the 5-year plan was allocated to infrastructure development. Electricity generating capacity was to increase 80% by the construction of two powerstations in Aden and one in Mukalla with a total capacity of 80 megawatts. PDRY and the Yemen Arab Republic (YAR) received a loan from the AFESD to help finance a 150-kilometer road linking Aden to Ta'izz in the YAR. Improvements in port facilities at Aden were to be made under the auspices of the AFESD and IBRD. Aden was once one of the world's largest oil bunkering ports but after the closure of the Suez Canal in 1967, this activity declined and has not resumed despite the reopening of the Canal. Renovation and modernization of the port was expected to cost $17.4 million. During 1976, negotiations were conducted with Saudi Arabia regarding the construction of an oil terminal on the Hadhramaut coast to be linked by transpeninsular pipeline to Saudi and other oilfields in the region.

Table 7.—People's Democratic Republic of Yemen: Foreign trade of crude petroleum and refinery products

(Thousand 42-gallon barrels)

Commodity	1974	1975 e	1976 e
EXPORTS AND REEXPORTS			
Petroleum refinery products:			
Gasoline	3,720	1,320	555
Jet fuel	1,889	1,100	1,027
Kerosine	1,071	733	631
Distillate fuel oil	3,788	1,270	1,936
Residual fuel oil	6,890	3,522	4,862
Other	30	429	168
Total	17,388	8,374	9,179
BUNKER LOADINGS			
Petroleum refinery products:			
Distillate fuel oil	404	NA	80
Residual fuel oil	1,104	NA	--
Total	1,508	NA	80
IMPORTS			
Petroleum, crude	19,930	12,150	13,965
Petroleum refinery products:			
Gasoline	617	520	357
Jet fuel and kerosine	303	240	77
Distillate fuel oil	598	498	769
Residual fuel oil	34	--	220
Lubricants	--	3	16
Other	--	210	225
Total	1,552	1,471	1,664

e Estimate. NA Not available.

Source: U.S. Department of Energy. International Petroleum Annual, 1977.

YEMEN ARAB REPUBLIC [25]

The mineral industry of the Yemen Arab Republic (YAR) was a minor contributor to the nation's economy during 1976. Mineral industry activity was limited to the production of cement, the mining of salt, and oil exploration in the Red Sea. The nation's economy continued to expand at a modest rate despite an inflation rate of 35% during the year. The balance of

[25] Prepared by David E. Morse.

trade deficit increased by $100 million [26] to approximately $350 million in 1976. Remittances from Yemenis working abroad more than offset the trade deficit and the YAR had a positive net balance of payments for the year.

The large-scale expansion of the As Salif port, completed during 1976, had suspended for the most part rock salt exports since 1973. Prior to that time, exports of rock salt from open pit operations at As Salif had averaged 70,000 tons per year. The new modern facilities were able to export rock salt at a rate of 1 million tons per year. The Government planned to produce chlorine, hydrochloric acid, and caustic soda, utilizing rock salt as feed.

The country's only cement plant at Bājil, near the nation's major port of Hodeida, continued to operate below its 50,000-ton-per-year capacity. A large portion of the YAR's cement needs was met by imports during 1976. A second cement plant with a 300,000-ton-per-year capacity was planned for the Hodeida area although financing and contractual agreements had not been arranged by yearend.

No oil was produced in the YAR during the year and petroleum products had to be imported. A Royal Dutch/Shell affiliate drilled an exploratory well in its 10,000-square-kilometer offshore Red Sea concession area during 1976. The Government announced plans to build a petroleum refinery at As Salif, one of the best natural harbors on the Arabian Peninsula, and to construct a petroleum products pipeline from the refinery to the capital, San'a, on the 8,000-foot central plateau. During 1976, petroleum products had to be transported by tanktruck to San'a, which added significantly to the cost of fuels in the central region.

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[26] Where necessary, values have been converted from Yemeni riyals (YRls) to U.S. dollars at the rate of YRls4.5 = US$1.00.

The Mineral Industry of Other Areas of South America

By Nicholas G. Theofilos [1]

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ECUADOR

Ecuador's real gross domestic product (GDP) increased 6% in 1976 despite persistent shortages of electrical power and essential fuels, which caused factory slowdowns and shutdowns. Petroleum export earnings, which made up more than 50% of total export value in 1976, totaled $565 million, a 9% increase over those of 1975.

A new 60,000-barrel-per-day oil refinery at Esmeraldas was scheduled to go on-stream in mid-1977, operating entirely on Ecuadorean crude. Corporación Estatal Petrólera Ecuatoriana (CEPE) started construction of a 600-kilometer network of product pipelines which was scheduled to be completed in 1977 to coincide with the completion of the refinery.

The Government was considering increasing the legally required production rate of 210,000 barrels per day to 240,000 barrels per day, starting in 1977, to offset the increasing domestic demand. To attain and maintain such an increase, large-scale exploration in the El Oriente region would have to be resumed. Petroleum produced in the El Oriente region was being piped 350 miles across the Andes to the coast at Balao. Reserves in the area were thought to be sufficient for at least 12 years at current production rates. Most of the oil produced there was by the CEPE-Texaco Inc.-Gulf Oil Corp. consortium. CEPE, in conjunction with an Argentine counterpart, planned to drill in new areas of the El Oriente jungle. CEPE also conducted a seismic study of 3,500 square kilometers on the Continental Shelf.

On June 21, 1977, Gulf ceased payments to Ecuador for the crude oil it lifted, placing the money in a special interest-bearing account pending settlement of several complaints against the Government. The Minister of Natural Resources had opposed Gulf's case for improved operating terms and had transferred the domestic marketing operations to State ownership.

At the La Plata mine, operated by Cia. Minera Toachi and Outokumpu Oy of Finland, annual output was scheduled to increase to 1,500 tons of copper, 3,000 tons of zinc, 4,823 troy ounces of gold, and 51,441 troy ounces of silver, all in concentrates, which were to be exported to Finland for smelting. Ore reserves were estimated at 180,000 tons.

A steelplant with an annual capacity of 400,000 tons was planned in the Posorja area, south of Guayaquil. The plant was scheduled to go into operation in 1981.

Uranerzbergbau GmbH, a West German company, was granted permission by the Government to start preliminary investigations for uranium prospecting.

[1] Foreign mineral specialist, International Data and Analysis.

Table 1.—Other Areas of South America: Production of mineral commodities

Area, commodity, and unit of measure	1974	1975	1976 p
ECUADOR			
Cadmium, mine output, metal content ---kilograms--	513	490	e 500
Cement, hydraulic ---thousand metric tons--	580	593	616
Clay, kaolin ---metric tons--	1,737	2,270	e 2,500
Copper, mine output, metal content ---do---	179	239	e 275
Gas, natural:			
Gross ---million cubic feet--	11,159	10,559	10,186
Marketable e ---do---	1,000	1,100	1,100
Gold, mine output, metal content ---troy ounces--	7,752	8,157	11,615
Gypsum (for cement) ---metric tons--	480	e 500	e 500
Iron and steel semimanufactures ---thousand metric tons--	33	29	NA
Lead concentrate, metal content ---metric tons--	143	119	e 110
Natural gas liquids:			
Natural gasoline ---thousand 42-gallon barrels--	109	139	128
Liquefied petroleum gases ---do---	63	53	e 50
Total ---do---	172	192	178
Petroleum:			
Crude ---do---	63,678	58,753	68,463
Refinery products:			
Gasoline ---do---	4,838	5,680	6,079
Jet fuel ---do---	960	446	467
Kerosine ---do---	594	1,429	1,915
Distillate fuel oil ---do---	3,113	3,162	2,886
Residual fuel oil ---do---	3,278	3,583	3,776
Lubricants ---do---	97	127	132
Other:			
Liquefied petroleum gas ---do---	37	50	40
Unspecified ---do---	13	15	20
Refinery fuel and losses ---do---	140	42	140
Total ---do---	13,070	14,534	15,455
Silver, mine output, metal content ---troy ounces--	35,277	37,026	52,000
Stone, sand and gravel:			
Limestone for cement ---thousand metric tons--	40	NA	NA
Quartz ---do---	5	10	NA
Sulfur, all forms e ---metric tons--	r 9,000	r 4,000	6,000
Zinc, mine output, metal content ---do---	202	83	140
FRENCH GUIANA			
Gold, mine output, metal content ---troy ounces--	1,138	2,437	2,820
GUYANA [1]			
Aluminum:			
Bauxite, dry equivalent, gross weight e --thousand metric tons--	3,250	3,250	2,640
Alumina ---do---	321	311	281
Diamond: [2]			
Gem e ---thousand carats--	17	12	8
Industrial e ---do---	12	8	6
Total ---do---	29	20	14
Gold, mine output, metal content ---troy ounces--	12,239	18,067	15,656
PARAGUAY			
Cement, hydraulic ---thousand metric tons--	103	138	155
Clays:			
Kaolin ---metric tons--	12,000	12,000	14,000
Other ---thousand metric tons--	650	780	1,100
Gypsum ---metric tons--	14,600	15,000	16,000
Lime ---do---	27,005	27,707	31,863
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels--	431	435	480
Jet fuel ---do---	65	46	53
Kerosine ---do---	125	109	127
Distillate fuel oil ---do---	564	834	899
Residual fuel oil ---do---	462	274	287
Other: Liquefied petroleum gas ---do---	75	52	39
Refinery fuel and losses ---do---	69	71	92
Total ---do---	1,791	1,821	1,977
Pigments, natural mineral: Ocher ---metric tons--	110	140	120
Sand, including glass sand e ---thousand metric tons--	601	841	981
Stone: e			
Dimension ---do---	97	108	130
Crushed and broken:			
Limestone (for cement and lime) ---do---	180	265	277
Other ---do---	1,520	2,050	2,380
Talc, soapstone, pyrophyllite ---metric tons--	250	120	140

See footnotes at end of table.

Table 1.—Other Areas of South America: Production of mineral commodities[1] —Continued

Area, commodity, and unit of measure	1974	1975	1976 p
SURINAM			
Aluminum:			
Bauxite, gross weight e ---thousand metric tons--	6,706	4,928	4,565
Alumina ---do----	1,185	1,148	1,155
Metal, primary[3] ---do----	54	26	46
Cement ---do----	43	31	50
Clays, common ---metric tons--	e 3,500	NA	NA
Gold, mine output, metal content ---troy ounces--	406	141	39
Sand and gravel:			
Sand:			
Common ---thousand metric tons--	250	200	[4]
Stone, sand e ---do----	3	3	NA
Gravel ---thousand cubic meters--	NA	25	[5]
Stone, crushed and broken ---thousand metric tons--	e 50	NA	137
URUGUAY			
Abrasives, natural corundum ---metric tons--	332	417	381
Aluminum, secondary ---do----	42	36	31
Barite ---do----	17	--	--
Cement, hydraulic ---thousand metric tons--	547	637	676
Clays, type unspecified ---metric tons--	325,461	310,947	425,704
Coke, gashouse ---do----	13,419	13,152	11,685
Feldspar ---do----	1,757	1,759	1,145
Fluorspar ---do----	211	65	50
Gas, manufactured ---million cubic feet--	878	836	753
Gem stones, semiprecious:			
Agate ---metric tons--	207	85	35
Amethyst ---do----	51	6	2
Iron and steel:			
Steel, crude ---do----	192	200	263
Steel semimanufactures ---do----	38,381	42,089	34,841
Lime ---thousand metric tons--	46	46	70
Petroleum refinery products:			
Gasoline ---thousand 42-gallon barrels--	2,223	2,243	2,051
Jet fuel ---do----	143	196	263
Kerosine ---do----	1,377	1,420	1,326
Distillate fuel oil ---do----	2,530	3,104	3,365
Residual fuel oil ---do----	5,303	5,478	5,062
Lubricants ---do----	1	2	1
Other:			
Liquefied petroleum gas ---do----	291	298	384
Unspecified ---do----	172	210	58
Refinery fuel and losses ---do----	174	260	229
Total ---do----	12,214	13,211	12,739
Sand and gravel:			
Sand, common ---thousand metric tons--	1,598	1,691	1,649
Gravel ---do----	NA	NA	864
Stone:			
Dimension ---do----	15	40	95
Crushed and broken:			
Alum schist ---metric tons--	84	1,546	1,441
Dolomite ---thousand metric tons--	24	42	34
Limestone ---do----	1,090	1,163	859
Marble ---do----	3	4	4
Quartz ---metric tons--	1,505	1,551	7,024
Other (including ballast) ---thousand metric tons--	1,871	1,508	1,115
Sulfur, elemental, byproduct ---metric tons--	120	2,000	2,000
Talc, soapstone, pyrophyllite ---do----	2,075	1,268	1,268

e Estimate. p Preliminary. r Revised. NA Not available.

[1] In addition to the commodities listed, a variety of crude construction materials (common clay, sand and gravel, and stone) undoubtedly are also produced, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2] Gem and industrial diamond production are estimated based upon a reported total production.

[3] Data represent exports.

[4] Reported volumetrically as 59,183 cubic meters.

[5] Reported as 26,000 tons.

FRENCH GUIANA

Minor quantities of gold, clay, sand and gravel, and crushed stone were produced in French Guiana during 1976 for local consumption.

The Bureau of Geological and Mining Research continued its survey of mineral resources. The survey reports were being made available to firms that had indicated an interest in the development of minerals in the country.

Development of the bauxite deposits, which have been known for a long time, was still not economically feasible under present world prices because of their low quality.

GUYANA

The Government-owned Guyana Bauxite Co. Ltd. (GUYBAU) experienced reduced bauxite and alumina production during 1976. However, the reduced production was offset by price increases, particularly for calcined bauxite, which accounted for over half of the bauxite exported from Guyana. Nevertheless, earnings for the bauxite industry and output of the country's main agricultural commodities were below the 1975 level, factors which caused a setback in the country's economy. The western industrial countries remained Guyana's major export markets for bauxite and alumina. In 1976, the United States purchased 34% of Guyana's calcined bauxite shipments and 37% of its dried bauxite exports.

The Government of Guyana actively promoted the concept of a common denominator unit within the membership of the International Bauxite Association (IBA) to cover sales of alumina and metallurgical-grade bauxite. This followed the promising initial performance of Guyana's composite currency unit (CCU), based on a basket of four internationally traded currencies, which had originally been devised for its own calcined refractory-grade bauxite.

Guyana's development plan centered around the bauxite industry. The Government planned a hydroelectric project on the upper Mazaruni River to be accompanied by construction of a large aluminum smelter. The Government expected to use power generated at Mazaruni to displace the country's total dependence on petroleum for power. The cost of the project was estimated at $120 million and was to be financed 52% by Guyana and 24% each by Trinidad and Tobago, and Jamaica.

As part of an effort to attract foreign private investment, the Government of Guyana was preparing an investment code to be released in 1977. During 1976, private investment was tolerated, but major projects were to be in partnership with the Government. Generally, the Government required majority participation, control of exports and imports, and eventual management control.

Table 2.—Guyana: Exports and reexports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Alumina:		
Hydrated	8,288	16,980
Unhydrated	306,811	308,111
Bauxite:		
Dried refractory	22,200	6,971
Calcined	779,720	784,024
Other	1,360	1,370
Metal, semimanufactures	(1)	NA
Copper metal including alloys, all forms	109	NA
Gold metal, unworked or partly worked, all forms	83,013	11,740
Iron and steel:		
Scrap	2,602	NA
Semimanufactures	548	2,926
Lead metal including alloys, all forms	73	NA
Platinum-group metals and silver	5	NA
Other, nonferrous scrap metal	(1)	NA
NONMETALS		
Diamond, gem	25,954	16,920
Precious and semiprecious stones, except diamond	48	1,445
Other, crude	(1)	NA
MINERAL FUELS AND RELATED MATERIALS		
Petroleum refinery products	5	NA

NA Not available.
[1] Less than ½ unit.

Table 3.—Guyana: Imports of mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975
METALS		
Aluminum:		
Bauxite ---value--	$1,396	NA
Metal including alloys, all forms	945	419
Copper:		
Copper sulfate	(1)	NA
Metal including alloys, all forms	94	NA
Gold metal, worked or partly worked ---troy ounces--	519	NA
Iron and steel metal including alloys, all forms	r 288,420	239,762
Lead metal including alloys, all forms	123	NA
Nickel metal including alloys, all forms	(1)	NA
Platinum-group metals, unworked and partly worked ---troy ounces--	35	NA
Silver metal, unworked and partly worked ---do---	9,054	NA
Tin metal including alloys, all forms	9	NA
Zinc metal including alloys, all forms	71	NA
Other:		
Oxides, hydroxides, peroxides of metals, n.e.s	595	NA
Metals including alloys, all forms	(1)	NA
NONMETALS		
Abrasives:		
Crude, natural	3	NA
Grinding and polishing wheels and stones	18	NA
Asbestos	10	NA
Barite and witherite	466	1,081
Cement	r 41,213	5,098
Clays and clay products (including all refractory brick):		
Clays	r 232	NA
Clay products ---value--	r $803,100	NA
Diatomite	15	NA
Fertilizer materials:		
Manufactured:		
Nitrogenous	r 37,614	27,769
Phosphatic	r 4,517	15,722
Potassic	r 5,221	5,351
Other, including mixed	r 14	NA
Ammonia	16	NA
Gypsum and plaster	463	NA
Lime	6,484	NA
Mica, worked	14	NA
Pigments, mineral, including processed iron oxides	2	NA
Precious and semiprecious stones, including diamond ---carats--	3,231	NA
Salt	r 3,885	5,504
Sodium and potassium compounds, n.e.s.:	r 50,874	13,903
Caustic soda	1	NA
Caustic potash, sodic and potassic peroxides	213	NA
Sodium carbonate		
Stone, sand and gravel:		
Dimension stone:		
Crude and partly worked	r 145	NA
Worked	24	NA
Gravel and crushed stone	4	NA
Limestone (pulverized)	34,879	58,629
Sand, not metal bearing	30	NA
Sulfur:		
Elemental	4	NA
Sulfuric acid	1,250	NA
Other, crude	13	NA
MINERAL FUELS AND RELATED MATERIALS		
Asphalt and bitumen, natural	r 5,434	1,758
Coal	31	NA
Coke	69	NA
Hydrogen, helium, rare gases	85	NA
Petroleum refinery products:		
Gasoline ---thousand 42-gallon barrels--	381	395
Kerosine and jet fuel ---do---	r 175	224
Distillate fuel oil ---do---	1,123	1,218
Residual fuel oil ---do---	1,819	2,289
Lubricants ---do---	r 64	71
Other:		
Liquefied petroleum gas ---do---	r 65	57
Mineral jelly and wax ---do---	r 1	NA
Asphalt and road oil ---do---	r (1)	NA
Unspecified ---do---	r 47	NA
Total ---do---	r 3,675	4,254
Mineral tar and other coal-, petroleum-, or gas-derived crude chemicals	191	NA

r Revised. NA Not available.
1 Less than ½ unit.

PARAGUAY

Cement is the most important mineral produced in Paraguay (155,000 tons in 1976). Sizable resources of nonmetallic minerals (marble, limestone, kaolin, talc, and gypsum) are known to exist in undetermined quantities, but they were produced only for domestic consumption. Small iron ore, manganese, and copper deposits exist in eastern Paraguay, but there were no known plans to exploit them.

The Government and Anschutz Corporation of the United States signed an agreement for the exploration of a concession area covering 168,000 square kilometers in eastern Paraguay. The 7-year agreement allowed exclusive exploitation of metallic and nonmetallic minerals, including radioactive and precious metals.

The search for petroleum in Paraguay was shifting into high gear, with five exploratory wells scheduled to be drilled in early 1977 by Texaco Paraguay, Inc., and Chaco Exploration Co.

The mammoth Itaipu hydroelectric project under construction jointly by Paraguay and Brazil employed 15,000 workers, 85% of whom were Paraguyans. The project brought about $100 million in foreign exchange to Paraguay in 1976, part as payment for Paraguyan goods and services and part as capital transfers.

A second proposed hydroelectric project at Yacyretá, to be built in conjunction with Argentina, was contingent upon financing. If financed, work is scheduled to begin late in 1978. Completion of these dams should provide Paraguay with relatively cheap hydroelectrical power, with some of it available for the export market.

Table 4.—Paraguay: Imports of mineral commodities [1]

(Metric tons unless otherwise specified)

Commodity		1974	1975
METALS			
Aluminum metal, all forms		310	184
Copper metal, all forms		10	9
Iron and steel metal, all forms		24,845	21,261
Lead metal, all forms		6	22
Tin metal, all forms		22	9
NONMETALS			
Salt		27,317	22,965
Crude minerals, not further described		10,722	11,719
MINERAL FUELS AND RELATED MATERIALS			
Asphalt, natural		3,136	2,912
Petroleum:			
Crude	thousand 42-gallon barrels	1,782	1,597
Refinery products:			
Distillate fuel oil	do	r 374	173
Residual fuel oil	do	37	64
Lubricants	do	r (2)	--
Other	do	74	110
Total	do	r 485	347

r Revised.

[1] In addition to the commodities listed, Paraguay reports imports of "precious stones and metals" totaling 3 metric tons in 1974 and 2 metric tons in 1975.

[2] Less than ½ unit.

SURINAM

Surinam began its first year of independence with a generally depressed bauxite industry and a stagnant economy. Bauxite shipments both by Aluminum Co. of America's (Alcoa) wholly owned subsidiary Suriname Aluminum Co. (SURALCO) and the Royal Dutch/Shell-owned NV Billiton Maatschappij Suriname declined more than 10% from the 1975 level. The decline was attributed to the multiyear contracts that the companies had with their customers and the long rainy periods which made mining difficult.

Negotiations between the Government and Billiton brought a quick agreement on the Government's bauxite levy for 1976. Despite Billiton's plea for financial relief, the agreement continued the levy at the same rate as in 1974 and 1975. However, the Government did not insist on bauxite production guarantees from Billiton as it did in the case of SURALCO. SURALCO guaranteed a minimum total bauxite production of 8.4 million tons during the 3 years of the agreement.

The Government's program to develop an integrated bauxite-to-aluminum project was underway with the partial completion of a railroad line connecting the deposits in western Surinam with the port of Apoera on the Corantijn River. The Government-owned company Grassalco was to be the developer.

Despite negative results throughout the year, interest in petroleum exploration remained alive. Esso Standard Oil Co. began new seismic and geophysical investigations offshore with much optimism.

The Government of Surinam and Placer Development Ltd., a Canadian company, signed an agreement for further exploration in the Brokopondo District where gold had been mined previously. The Government was taking steps to encourage domestic entrepreneurs to get involved in small-scale mining.

As part of its import substitution effort and to meet local demand for building materials, the Government decided to establish a brick industry in the Para District. The factory, with a proposed capacity of 30,000 to 50,000 brick per day, was to create an additional 100 to 150 jobs.

The Government continued to seek external financing for the multimillion-dollar Kabalebo hydroelectric project, which was to be principally financed by development aid from the Netherlands.

The Norwegian firm A/S Ardal og Sunndal Verk, owner of a process for extraction of iron from lateritic bauxite ores, sent a mission to Surinam early in 1976 to investigate the feasibility of a local iron and steel industry.

Table 5.—Surinam: Exports of mineral commodities [1]

(Metric tons)

Commodity	1974	1975	Principal destinations, 1975
Aluminum:			
Bauxite	3,320,140	2,170,031	United States 1,952,000; Canada 113,303; West Germany 54,098.
Oxide (alumina) and hydroxide	1,111,417	1,056,368	United States 441,618; Norway 236,835; Netherlands 218,475.
Metal including alloys, all forms	33,816	25,039	United States 11,837; West Germany 8,011.

[1] Compiled from import statistics of selected trading partner countries.

URUGUAY

Uruguay's modest mineral industry experienced a further disappointment in 1976 with the failure of exploratory offshore drilling for petroleum. The GDP, however, increased 4% (in 1961 prices), following many years of little or no increase.

The Administración Nacional de Combustibles, Alcohol y Portland (ANCAP), which had a monopoly on the import, refining, and distribution of hydrocarbons and the manufacture of cement, was under consideration to have some of its uneconomic functions transferred to the private sector. This would be consistent with the Government's policy of reversing the trend of nationalization that was predominant in the last 50 years.

South African technical assistance was provided to explore coal deposits in the three northeastern departments along the Brazilian border. These deposits were thought to be an extension of occurrences that had been previously exploited on the Brazilian side of the border. They were discovered in the 1920's but had not been mined in Uruguay because of their slaty nature and high sulfur content.

The Mineral Industry of Other South Pacific Islands

By Charlie Wyche[1]

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BRITISH SOLOMON ISLANDS

The British Solomon Islands Protectorate continued developmental work on bauxite deposits on the Islands of Rennell and Vaghena. A feasibility study was completed by Mitsui Mining & Smelting Co., Ltd., and Pacific Aluminum Ltd. (a subsidiary of Conzinc Riotinto of Australia Ltd.), and negotiations with the Government were in progress. The Government will receive a 25% share if the project is realized. It was estimated that the Islands contain 60 million tons of bauxite with an alumina content of 45% to 50%.

[1] Physical scientist, International Data and Analysis.

Table 1.—Other South Pacific Islands: Production of mineral commodities

Area, commodity, and unit of measure	1974	1975	1976 p
BRITISH SOLOMON ISLANDS [1]			
Gold ---troy ounces--	873	804	6,000
CHRISTMAS ISLAND [1]			
Phosphate rock (shipments) ---thousand metric tons--	1,809	1,391	1,033
FIJI			
Cement, hydraulic ---metric tons--	85,348	74,000	69,000
Gold, mine output, metal content ---troy ounces--	68,890	68,744	65,757
Lime ---metric tons--	--	2,826	2,666
Silver, mine output, metal content ---troy ounces--	27,101	26,462	19,773
Stone, sand and gravel:			
Coral sand for cement manufacture ---metric tons--	124,980	55,608	78,316
River sand for cement manufacture ---do----	56,056	45,887	52,783
River sand and gravel ---cubic meters--	570,991	551,550	851,762
Coral sand and limestone ---do----	328	NA	NA
Limestone ---metric tons--	3,066	NA	NA
Other quarried stone ---cubic meters--	191,831	262,497	181,683
Tellurium metal ---kilograms--	--	--	1,109
NAURU AND OCEAN ISLAND [1]			
Phosphate rock, marketable: [2]			
Nauru ---thousand metric tons--	2,288	1,534	755
Ocean Island ---do----	548	516	417
NEW CALEDONIA			
Chromium, chromite, gross weight ---metric tons--	--	2,051	9,537
Cobalt contained in metallurgical products of nickel: e			
In ferronickel ---do----	1,450	1,580	1,150
In matte ---do----	130	130	170
Total ---do----	1,580	1,710	1,320
Nickel:			
Ore:			
Gross weight ---thousand metric tons--	6,961	6,693	5,921
Metal content [3] ---metric tons--	128,015	115,761	109,912
Metallurgical products, nickel content:			
In ferronickel ---do----	48,533	52,802	38,142
In matte ---do----	18,837	18,266	23,759
Total ---do----	67,370	71,068	61,901
Stone, sand and gravel:			
Stone:			
Crude (unspecified) ---cubic meters--	--	58,000	38,000
Crushed ---do----	196,000	170,000	108,000
Sand ---do----	128,000	82,000	63,000
Silica (for metallurgical use) ---do----	18,627	21,358	28,862
NEW HEBRIDES [1]			
Manganese:			
Ore e ---metric tons--	295,000	290,000	287,000
Concentrate, gross weight ---do----	47,311	46,520	e 46,000
PAPUA NEW GUINEA [1]			
Copper, mine output, metal content ---do----	182,868	172,477	175,806
Gold, mine output, metal content ---troy ounces--	r 677,237	611,356	1,228,574
Silver, mine output, metal content ---do----	r 1,493,283	1,384,325	1,840,628

e Estimate. p Preliminary. r Revised. NA Not available.

[1] These areas undoubtedly produce crude construction materials (common clays, sand and gravel, and/or stone) in addition to the listed commodities, but output is not reported and information is inadequate to make reliable estimates of output levels.

[2] Exports.

[3] Nickel-cobalt content of metallurgical plant products, plus nickel-cobalt in exported ores.

CHRISTMAS ISLAND

Phosphate rock and dust remained the only mineral commodity produced on Christmas Island during 1976. The commercial history of the Island, located in the Indian Ocean 2,600 kilometers northwest of Perth, Australia, dates from 1900. As of yearend 1976, some 24.3 million tons of phosphate had been produced in the Island's history.

Owing to strong demand in Malaysia, output of phosphate rock increased about 8%. The 1.4 million tons produced was valued at about $80 million.

The base rock of the Island is volcanic and is covered by coral limestone that forms an irregular pattern of pinnacles. The coral limestone is covered by phosphate in beds averaging 6 meters in depth. There are three basic grades of phosphate, ranging from 25% to 36.5% P_2O_5. The average grade of phosphate exported ranges from 32% to 35% P_2O_5.

Table 2.—Christmas Island: Shipments of phosphate rock, by destination
(Thousand metric tons)

Destination	1974	1975	1976
Australia	1,222	796	480
Indonesia	24	13	7
Malaysia and Singapore:			
Malaysia	145	132	133
Singapore	418	402	417
New Zealand			
Total	1,809	1,343	1,037

Source: International Superphosphate & Compound Manufacturers' Association Ltd.

FIJI

Gold and river sand and gravel were Fiji's principal mine and quarry products. In 1976, these products accounted for $11.7 million,[2] or 88% of the total mineral value of $13.3 million. Quarried stone and coral sand contributed $1.1 million, and other minerals supplied the remaining $0.5 million.

Gold, silver, and tellurium were produced by Emperor Gold Mining Co. Ltd., a wholly owned subsidiary of Emperor Mines Ltd. The company produced 65,757 troy ounces of gold, 19,773 troy ounces of silver, and 1,109 kilograms of tellurium during the year. The average price of gold fell to $131.61 per troy ounce; Emperor Gold Mining consequently recorded a net loss of $884,530. The company gave serious consideration to closing down the whole operation because of the unfavorable economic conditions. The Emperor Gold Mining mine was Fiji's largest employer, and every effort was made to postpone the decision; at yearend, no decision on the future of the mine had been reached. Measured reserves were estimated at 1.3 million tons averaging 0.3 troy ounce of gold per ton.

Production of river sand and gravel nearly doubled that of 1975. Output of both coral sand for cement manufacture and limestone also increased substantially.

Diamond drilling by Emperor Mines near the Old Misty mine, south of Nandi, proved to be disappointing and the prospecting license was relinquished. Preliminary results of stream-sediment and soil-sampling surveys at Mount Kasi on Vanua Levu Island were encouraging, however, and an additional license was obtained. Emperor Mines was seeking partners for a joint venture to continue exploration in this area.

An exploratory drilling program carried out in the Tavua Basin and Nasivi Delta areas of Fiji by Anglo Pacific Exploration Ltd., Mount Isa Mines Ltd. (MIM), and Emperor Gold Mining established that the overall gold content of the alluvium was not economical.

[2] Where necessary, values have been converted from Fijian dollars (FD) to U.S. dollars at the rate of FD1=US$1.17.

NAURU AND OCEAN ISLAND

The Republic of Nauru and Ocean Island (the latter a member of the Gilbert and Ellice Islands Colony) lie just south of the equator, halfway between Honolulu, Hawaii, and Melbourne, Australia. Nauru's per capita income of $22,500 in 1976 was the world's highest. Phosphate rock remained the sole mineral produced on both islands, and the total output was exported.

The combined phosphate rock output of 1.2 million tons was 43% below that of 1975, owing to decreased demand in Australia and New Zealand. Income from the phosphate rock, which averaged 83% P_2O_5, totaled more than $130 million in 1976.

A calcining plant operated by Nauru Phosphate Corp. began production during the year. The plant treated surface rock previously not exported because of low phosphate content. Capacity of the two calciners in the plant was approximately 400,000 tons of P_2O_5 per year.

Table 3.—Nauru and Ocean Island: Shipments of phosphate rock, by destination
(Thousand metric tons)

Destination	Nauru		Ocean Island	
	1975	1976	1975	1976
Australia	918	305	303	278
Japan	114	7	--	--
Korea, Republic of	50	48	--	--
Mexico	23	--	--	--
New Zealand	417	369	218	142
Taiwan	12	26	--	--
Total	1,534	755	521	420

Source: International Superphosphate & Compound Manufacturers' Association Ltd.

NEW CALEDONIA

The French island territory of New Caledonia, about 1,600 kilometers east of Australia's Queensland coast, continued as one of the world's major nickel producers. The political and administrative organization of New Caledonia, located at the capital city Nouméa, was headed by a high commissioner, a territorial assembly, and a council of government. In France, the territory was represented in Parliament by one deputy and one senator.

Nickel operations were dominated by Société Métallurgique le Nickel (SLN), a subsidiary of the French Imétal S.A. and Elf-Aquitaine groups. SLN produced garnierite ores from several mining centers on the island. Some of the company's output was shipped as ore directly to Japanese smelters when demand was strong. However, most was shipped to SLN's Doniambo smelter at Nouméa.

The local territorial assembly passed legislation improving the fiscal position of mining companies on the island. The legislation imposed a 50% tax on industrial and commercial profit but abolished the heavy export tax. Because of a more favorable tax structure and increasing demand for nickel, SLN announced a $200 million[3] expansion plan.

TRADE

Exports of minerals, mainly nickel ore, ferronickel, and nickel-cobalt matte, were valued at about $360 million in 1976, compared with $371 million in 1975. Exports of nickel ore, mainly to Japan, increased from 2.5 million tons in 1975 to 2.7 million tons in 1976. The average grade of exported nickel ore was 2.38% nickel plus cobalt. Exports of ferronickel and matte during the year totaled 51,490

[3] Where necessary, values have been converted from New Caledonian francs (CFPF) to U.S. dollars at the rate of CFPF86.14=US$1.00.

tons of nickel content—38,169 tons in ferronickel and 23,759 tons in matte. More than 75% of the ferronickel and 50% of the matte was shipped to France. The remaining ferronickel was shipped to the United States, Japan, and Australia. Of the remaining matte, the United States was the principal recipient, followed by Japan, Canada, and Finland.

Table 4.—New Caledonia: Exports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity [1]	1974	1975	1976
Chromite, gross weight (50.045% Cr_2O_3)	3,566	1,001	NA
Nickel:			
Ore, gross weight [2] thousand tons	3,347	2,466	2,693
Smelter products, nickel content:			
Ferronickel:			
Electric grade (FN4 grade, 25.1% nickel-cobalt)	r 12,481	11,546	10,305
Sulfur-extracted grade (FN3 grade, 24.5% nickel-cobalt)	8,620	10,613	6,151
Refined grade (FN2 grade, 26.3% nickel-cobalt)	670	382	3,622
Overrefined grade (FN1 grade, 27.5% nickel-cobalt)	9,896	9,014	
Other:			
FN5 grade, nickel-cobalt content not specified	442	--	--
FNC grade, nickel-cobalt content not specified	15,014	11,104	10,136
Nickel matte (79% nickel-cobalt)	20,073	19,417	21,276

r Revised. NA Not available.

[1] Cobalt content of smelter products not available.

[2] Nickel-cobalt content reported as follows, in tons: 1974—60,645; 1975—44,693; and 1976—47,984.

Source: Service de la Statistique. Annuaire Statistique de la Nouvelle Caledonie, 1977 (Nouméa). 1977, pp. 115, 119.

Table 5.—New Caledonia: Imports of selected mineral commodities

(Metric tons unless otherwise specified)

Commodity	1974	1975	1976
Cement	98,712	53,116	43,495
Coal	108,665	--	--
Coke	18,858	11	--
Gypsum	13,535	--	--
Iron and steel:			
Bars	6,014	5,915	4,872
Angles, shapes, sections	3,578	2,251	2,261
Plates and sheets	6,021	4,250	4,842
Petroleum refinery products:			
Gasoline thousand 42-gallon barrels	346	415	460
Kerosine do	37	32	37
Distillate fuel oil do	1,068	403	383
Residual fuel oil do	4,183	4,305	3,513

Source: Service de la Statistique. Annuaire Statistique de la Nouvelle Caledonie, 1977 (Nouméa). 1977, pp. 175–176.

COMMODITY REVIEW

Chromite.—Output of chromite by Société de la Tiébaghi was 9,537 tons, more than four times the 1975 output. Most (9,105 tons) was exported, mainly to Japan. The ore contained 45.7% Cr_2O_3 and 0.8% moisture.

An exploration program for chromite by International Nickel Co. of Canada Ltd. (INCO), through its French subsidiary Société de la Tiébaghi, continued. INCO reached an agreement with Compagnie Minière Dong-Trieu and Compagnie Financière de Paris et des Pays-Bas on the terms of an exploration program and feasibility studies. The 18-month program, which was expected to cost around $4 million, started at the end of 1976. If it proves economically viable to reopen the mine in the prospect area, the property could be brought into production by 1980.

Nickel.—Nickel ore production dropped 11.5% below that of 1975. SLN, with operations at four main mining centers on the island, remained New Caledonia's principal ore producer. Its main mining areas were Népoui and Kouaoua. Nickel output was limited by the capacity of the Doniambo smelter, located at Nouméa, which was about 85,000 tons per year of nickel contained in ferronickel or matte. This level was achieved only by utilizing the old blast furnace section and the newer electric furnaces. The company planned to increase output to 100,000 tons per year at an estimated cost of $200 million. The first $40 million would be expended in 1977, and the full program would be completed in 1981. Nickel ore production at two of SLN's mining centers would be substantially expanded. Output at Népoui, the largest, would increase to around 2 million tons per year. At Kouaoua, ore production would be increased to 1.2 million tons per year, twice the current output. Ore from Népoui was shipped to a central ore-transfer point, then carried portside by a 13-kilometer-long belt conveyor. The conveyor had a capacity of 800 tons per hour and would easily handle the expanded tonnage. Reserves at both Kouaoua and Népoui were considered sufficient to support the projected expansion program.

In addition to the SLN expansion, there was the Compagnie Française d'Entreprises Minières Métallurgiques et d'Investissements (COFREMMI) program in the northern part of the island. Originally a subsidiary of Patino N.V., COFREMMI was owned 90% by the French Government agency Bureau de Recherches Géologiques et Minières (BRGM). COFREMMI was involved in feasibility studies for a $150 million project on garnierite deposits at Tiébaghi, Poum, and Ile Cert. The program was to produce 40,000 tons per year of ferronickel. Initially it was anticipated that COFREMMI would complete the feasibility studies before inviting other overseas mining companies to participate in a development scheme; however, in late 1976, other companies were asked to submit metallurgical appraisals.

NEW HEBRIDES

Manganese remained New Hebrides' only mineral product. Output by Cie. Française des Phosphates de l'Oceanie at the Forari manganese mine on Efate Island declined slightly from that of 1975. The ore was upgraded to a 42% manganese concentrate which was exported, mainly to Japan. The past 10 years' production and export data are as follows, in tons of contained manganese:

Year	Production	Exports
1967	27,658	27,948
1968	21,306	17,432
1969	--	--
1970	5,948	11,057
1971	5,811	5,776
1972	10,942	14,548
1973	12,674	10,840
1974	19,871	17,225
1975	19,538	18,340
1976	19,320	NA

NA Not available.

PAPUA NEW GUINEA

One year after national independence, Bougainville Copper Ltd.'s copper mine at Panguna remained the only significant mining operation in Papua New Guinea. Exploration was widespread, mainly for copper but also for other minerals such as nickel, chrome, bauxite, molybdenum, and petroleum. Limestone and sand were produced for local use and gold was produced in the Bulolo-Wau area. With slightly higher copper production, the total mineral value increased to around $258 million.[4] Copper prices, however, remained at the depressed levels of 1975, despite a brief midyear rally. The average price of gold was higher, but there was no change in the price of silver. The country's gross national product (GNP) was estimated at $1.2 billion, of which mineral output accounted for 21%.

A contract between the Government and OK Tedi Development Co. was concluded along the general lines of the renegotiated

[4] Where necessary, values have been converted from Papua New Guinea dollars (K$) to U.S. dollars at the rate of K$1=US$1.26.

Bougainville Copper agreement. An agreement was also reached with seven major U.S. oil companies conducting exploration in the Gulf of Papua. The policy included a basic income tax on oil and gas production to be paid to the province in which the oil was located. The Government indicated that an additional profit tax to oil producers would be equal to 50% of after-tax cashflow. No additional profit tax would be charged for natural gas, but the Government would take a free participation share equivalent to a royalty of 8% to 16%, depending on production.

The Mineral Resources Stabilization Fund was set up through which would pass all income accruing to the Government from major natural resource projects. The aims were to insure an even flow of income to the Federal budget and to insulate the economy from price fluctuations in the world market.

COMMODITY REVIEW

Copper.—The Panguna operation accounted for 61% of total export earnings of $431 million in 1976. Bougainville Copper, the operating company, was owned by Conzinc Riotinto (53.6%), the Government (20%), and public shareholders (26.4%). The company was incorporated in 1967, and production and export of copper concentrates began in 1972. The Panguna ore body was worked by open pit methods and the concentrates were slurried and pumped to the port of Anewa on the east coast of Bougainville Island, a distance of 25 kilometers.

In 1976, the mill treated 32.23 million tons of ore and produced 596,833 tons of concentrate containing 175,806 tons of copper, 20,222 kilograms of gold, and 45,387 kilograms of silver. Sales totaled 179,081 tons of copper, 20,494 kilograms of gold, and 46,065 kilograms of silver. Contract shipments to Japan were curtailed during 1975 and 1976, but the company was able to sell all of its production. Bougainville Copper announced that it would spend $12 million over the next 2 years to build a tunnel into the nearby mountain range to drain the open pit mine. The multi-million-dollar tunnel project was part of an overall efficiency plan being carried out by the company's engineering, operational, and work-force divisions. The mine was approximately 300 meters below the level of the nearby river system, and mine drainage was becoming increasingly difficult. The tunnel would run for 7 kilometers under the surface and emerge at a point where gravity would allow the water to drain into the river system.

Carpentaria Exploration Co. Pty. Ltd., a subsidiary of MIM Holdings Ltd., was developing a porphyry copper prospect in the Sepik River area with a consortium of Japanese companies comprising Sumitomo Metal Mining Co., Ltd., The Dowa Mining Co., Ltd., and Marubeni Corporation. The consortium could earn a 40% interest by spending $5 million on exploration and other work over a 5-year period. Reserves were estimated at 366 million tons of ore averaging 0.45% copper. The deposit is located in a very remote region.

The Government negotiated an agreement with Broken Hill Pty. Co. Ltd. (BHP) to form a consortium to complete the investigation at OK Tedi and study the economics of the whole project. The consortium reportedly comprised BHP (30%); Amoco Minerals Ltd., a subsidiary of Standard Oil Co. of Indiana (25%); and four West German metal processors (25%). The remaining 20% would be taken by the Government under an equity credit arrangement. Feasibility studies were scheduled for completion in January 1979, and if a mine is developed, it would be in operation by 1984.

Exploration work continued on the Yandera copper prospect, initially investigated by Kennecott Exploration Pty. Ltd. BHP, through its wholly owned subsidiary Dampier Mining Co. Ltd., agreed to spend $1.2 million to acquire a 61% interest in the project. Initial drilling indicated the presence of ore averaging 0.46% copper and 0.12% molybdenite.

On Manus Island, porphyry copper ore was being explored by a joint venture of Exoil N.L. (70%) and Transoil N.L. (30%). Buka Minerals N.L. was investigating copper, gold, zinc, and molybdenum deposits in New Britain. Nickel prospects of 1.1% nickel were being investigated by Eastern Pacific Mines Pty. Ltd., which engaged Carpentaria Exploration for surface mining.

Petroleum.—United States, Japanese, British, and Australian companies con-

tinued the search for crude oil and natural gas, but no commercial discoveries were made. Esso Australia Ltd.'s first well in the Gulf of Papua was dry, but Esso planned to spend another $10 million on a second well in the swamp between Gulf and Western Provinces. Both Cities Service Co. and Gulf Oil Corp. planned exploration in the Southern Highlands. The Government wanted the oil companies to intensify exploration activities.

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